



## E-HUB

*Energy-Hub for residential and commercial districts and transport*

### SEVENTH FRAMEWORK PROGRAMME

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## **D6.1. Description of market needs and business models in area of district level energy services**

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## Executive summary

The e-Hub project, funded under the FP7 programme “Energy efficient Buildings (EeB)” aims at developing energy infrastructure concepts that are able to utilise the full potential of renewable energies available at district level.

An important element is the identification of novel business models and energy services in order to overcome institutional and financial barriers, which is the subject of the present study

The aim of this deliverable report is to:

1. describe the market needs and business models (concept, content, earning logics, financing models and risk management) in the area of district level energy services.
2. study ideas and new emerging business and service models for e-Hub systems
3. present an overview of barriers and incentives for district energy concepts.

### 1. Description of the market needs and business models

To address the first aim, 23 national and EU projects were analysed. The most interesting cases in relation to the e-Hub project, having integrated energy systems and service concepts are listed in table 1 below.

Table 1: *On-going national and EU projects studied*

Project	Status	Scale	Services	Business model	Technology scope
<b>Linear</b>	On-going demoproject	Existing residential area	Active demand, dynamic pricing	N.A.	Flexible energy resources at consumer premises
<b>Power Matching City</b>	Operational	25 family houses	Electricity, domestic hot water	PPP	MicroCHP, HP, PV, Wind turbines, electric storage, power matching technologies
<b>Couperus smart grid</b>	Construction	288 flats + office	N.A.	PPP, test bed	Smart grid, H/C storage
<b>Polo Energie</b>	Operation / development	179 GWh/a	Heat, cool, maintenance	PPP	W2E, geothermal, solar
<b>Village of Laas South Tirol</b>	Operation	5.5.-6.5. MW <sub>H</sub>	Heat, maintenance	PPP+ cooperative	Biomass, biodiesel
<b>Alessandria (Italy)</b>	Operation	EcoVillage of 299+101+50 dwellings	Heat/Cool/ Electricity	N.A.	Biomass trigeneration, solar thermal, PV plant

The most common business model appeared to be the PPP (Public Privat Partnership) model that indicates that the public sector has an important role in introducing new energy service solutions. In the case of Alessandria (Italy), co-operatives participated to produce energy in the role of biofuel suppliers.

The reported cases clearly indicate that the maturity, penetration and application of different energy technologies vary from country to country. For instance district heating and cooling solutions are “business as usual” in northern Europe while still very rare in southern Europe.

The second method used to study the state-of-the-art of business models and services in the district energy business is a web based questionnaire. The questionnaire was translated into 6 languages (NL, IT, BE, PL, ES, FI) in addition to the English version and conducted during May-June 2012. A total of 933 responses were received, the majority coming from Italy (684), Belgium (154) and Finland (64). In the questionnaire, five main stakeholder groups were identified:

1. private person end user,
2. company end user,
3. service provider (energy provider, retailer, transmission operator etc.)
4. land area or real estate developer and
5. public authority or policy maker.

Separate actors within these main groups are presented in figure 1. It also presents the number of responses received for each stakeholder group. The group of “Others” includes persons such as experts and accredited energy auditors, who did not fit the predefined stakeholder groups.

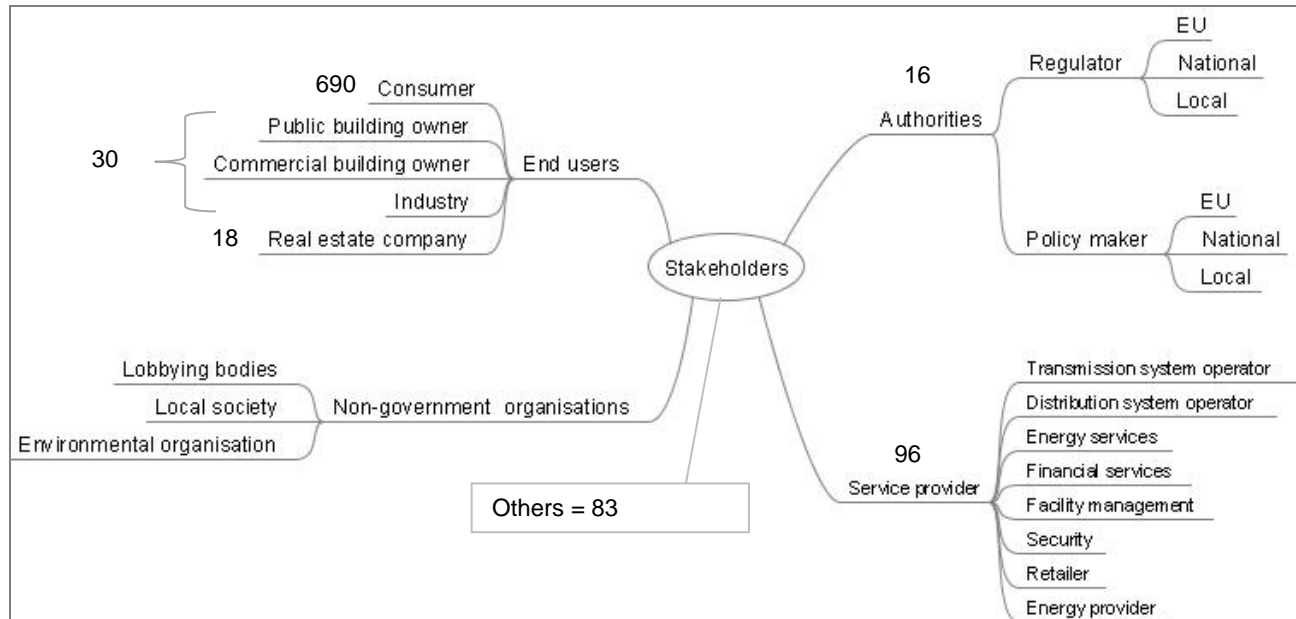


Figure 1. *Stakeholder groups*

The questionnaire consisted of 40 questions related to current energy services and possible new services. An interesting finding relates to the respondents opinion on new services, illustrated in figure 2.

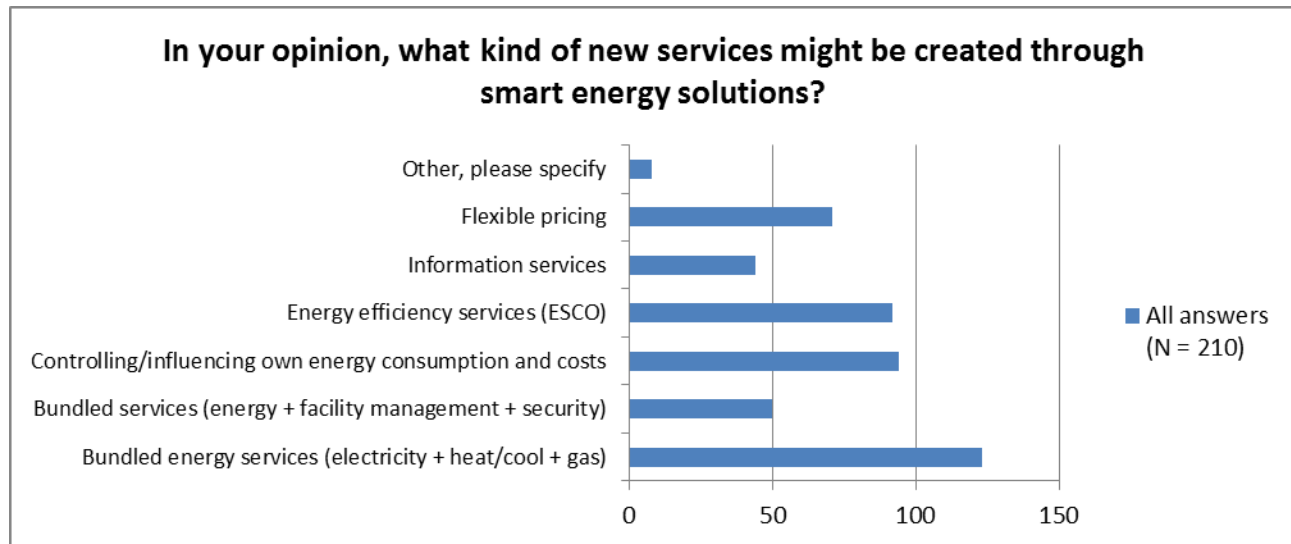


Figure 2. Responses to the question on new services in the questionnaire

Apparently, the most potential new service created through smart energy solutions according to the respondents, is bundled energy services. Also services regarding the control of energy consumption and energy costs are seen as a potential new service, as well as energy efficiency services (ESCO).

Also of interest were the answers of the non-end user stakeholder groups to the question what kind of services they would like to sell, illustrated in figure 3. The most popular alternative was energy efficiency services (ESCO), but bundled energy services and services regarding energy consumption controlling were also seen as interesting services.

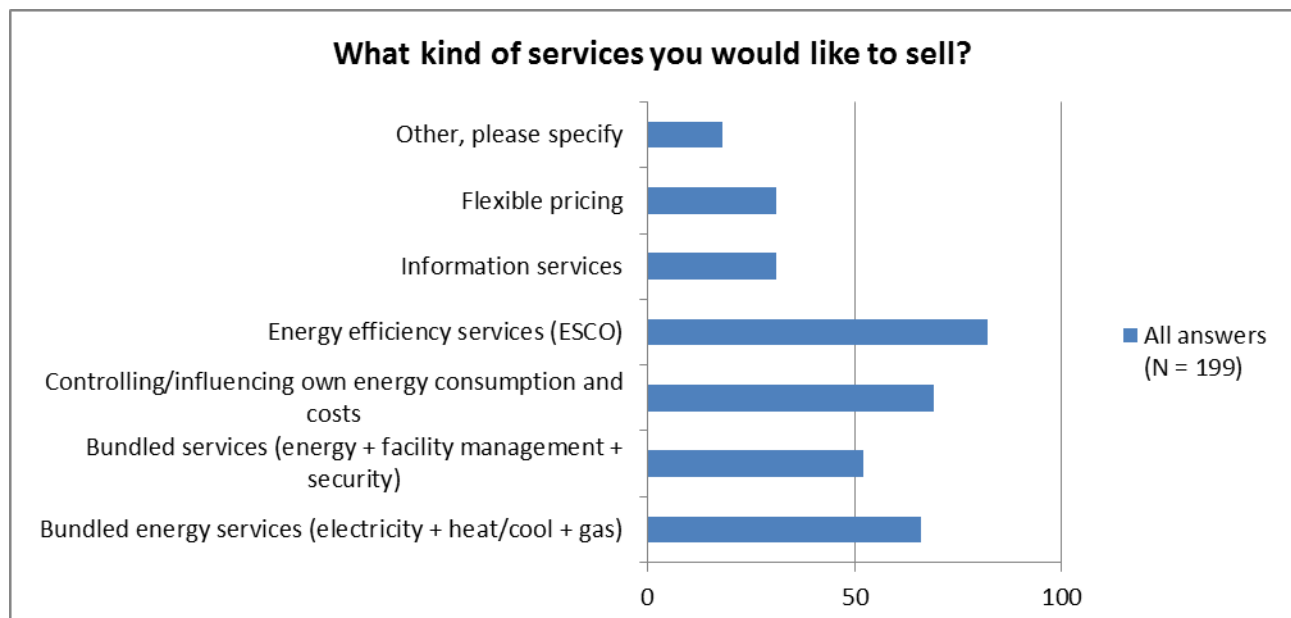


Figure 3. Responses to the question on services, which the respondents would be willing to sell.

## 2. Ideas and new emerging business and service models for e-Hub systems

The second aim was to **identify ideas and new emerging business and service models for e-Hub systems**. To address the issue, a number of country specific workshops and interviews were held.

The workshops and interviews were performed in 4 groups with local partners. The Belgium workshop focused on smart thermal networks and smart electricity grids. The Italian study was done by interviews focusing on 6 case studies. The Finnish study was done by one workshop with district heating companies and several interviews. The Netherlands study was done by 3 interviews focusing on a case projects and 3 workshops with stakeholders in district projects.

A set of common research questions was set as the basis for the workshops and interviews and a common fact sheet was developed for helping the description of the cases.

The main conclusions from the workshops and interviews are the following:

Markets and needs will change. Local energy supply is important, but we must have a broader look at interactions on various scales, from local to national and even European in order to be able to match demand and supply. An holistic approach is important, from a smart city to a smart country and smart Europe. The whole system and all energy forms (gas, electricity, heat, cold and mobility) should be taken into account. Distributed generation at district level is gaining importance although most distributed generation is currently being installed at building level.

The established energy businesses, like for instance district heating - popular in the Nordic countries but penetrating in the other European countries - will face challenges in order to be competitive in the future as low and passive energy construction will become common practice (Finland, Belgium). New services (e.g. smart metering of heat) and pricing systems, financing models, new technologies like hybrid heating systems are requested by the markets.

Furthermore, introduction of financial support to switch to district heating (Sweden, Germany, Finland, Belgium) will improve the competitiveness of district heating. High connection fees were identified as an important barrier for the customers to choose district heating, and new pricing models could be used to reduce this problem (for example lengthening the payment time or providing an option of renting the heat distribution center). Additional energy services as district cooling may make district heating more attractive (e.g. in the Turin project). Offering bundled services, including feedback on energy consumption are also expected to have an impact.

Interests, roles and needs of stakeholders in energy service business are changing: with an emerging **tendency among consumers to invest in private energy generation**. This was also reported in the web questionnaire.

The role of the municipality is changing. It is no longer possible for municipalities to realize a set of goals by themselves. While the attention used to lay on actions the municipality could initiate itself, it now depends on the situation what role is taken. The municipality used to formulate environmental goals as a separate policy line. People do not want to be patronized by organisations or the government, but they want to be independent and to decide for themselves on issues related to their surroundings and take action. **People wish to be involved in the decision process in the early stages**. In a town/city, the local lower authorities or housing cooperations could/should get involved. Also activation and integration of community is included as residents are interested about what is going on in the residential area.

**Service designers and psychologists emphasize that product and service concepts should be simple**, user friendly and that they appeal to people. Social sharing and visualization usually helps. There are models in which end customers see their consumption compared to a similar household's average and people can get small rewards if their energy consumption is less than average and they belong to group of top 10 % having lowest energy consumption (or highest energy efficiency).

Decentralised energy generation, which is currently rolled out on a large scale, requires much more active roles on the part of different parties who have remained passive up to now. New parties are also joining in. **Each stakeholder should have its own, clearly defined role**. Program responsibility as we know it will disappear. There will be, however, a need for a regional planning function to determine the zoning for generation capacity for a period of e.g. the next 20 years, coordinated by Central Authority (such as government or Ministry of Energy or Energy Independent Authority). This can be filled in with concessions (PPP models).

**The current system is not tailored to local initiatives for energy generation and supply.** The process needs to be facilitated, people need to be guided, but this cannot be enforced. Developments in PV installations, for example, are progressing so rapidly at the moment that it is difficult to facilitate this from the central system. This requires high flexibility from the stakeholders and technology. One example is the smart meters: these are not functioning properly because the preparation takes five years.

**The current pricing mechanism is no longer appropriate, and should be changed.** Price incentives for local generation are too low at the moment. We should take the whole range of energy requirements of the users into account: lighting, power, heat (high – or low-temperature), mobility, cooling, and comfort. Also information has its value. This may lead to new products and services such as charge-my-car, ESCO-services etc.

It could be imaginable that a minimum energy package is available for everyone with the risk that energy is not available on certain hours. A commercial party could offer you additional energy services (e.g. guaranteed energy supply) against additional fees. Now there is no choice.

Energy by itself generally does not raise much interest, so a service provider has to include other services into the offer. A key finding (in Finland) is that there is demand for turnkey solutions and some kind of service integrator. End customers can't sort out all different technology providers, processes, licenses and subsidies. Thus there should be only one interface or service provider to coordinate all processes with subcontractors and partners, thus '**unburdening**' the end user. New service design is needed to get consumers involved and willing to pay for new technologies. Facilitators might emerge to help existing businesses with their smart solution transition, by providing information about business opportunities and enhancing collaboration between different industry actors.

### 3. Barriers and incentives for district energy concepts

The third aim was to **assess legislative barriers and incentives for new energy business and services**, which was addressed by carrying out a literature study.

At the European level, activities of ESCOs are subject to obligations laid down in European Energy Law (Electricity Law and Gas Law). The Third Energy Package, including Directive 2003/54/EC concerning common rules for the internal market in electricity and Directive 2003/55/EC concerning common rules for the internal market in natural gas, is of special importance. These directives establish common rules for the generation, transmission, distribution and supply of electricity and natural gas. In addition, in the directive 2002/91/EC on the energy performance of buildings, ESCOs are included. Member States must implement these obligations in their own legislation. Other than that, Member States are free to enact their own national legislation.

Legal issues were addressed for three relevant **issues with respect to ESCOs**: the ability for **consumers to change supplier in all circumstances, transport tariffs and smart energy systems**.

Smart energy services are often based on the utilization of renewable energy. Thus incentives and other support instruments are important to promote local generation of energy and new energy services. Incentives considered are:

- Quantity-based market instruments (Quota obligation, Tendering) and
- Price-based market instruments (Feed in tariff and premium tariff, Fiscal incentives)

Figure 4 below gives an overview of the various incentives in the EU.



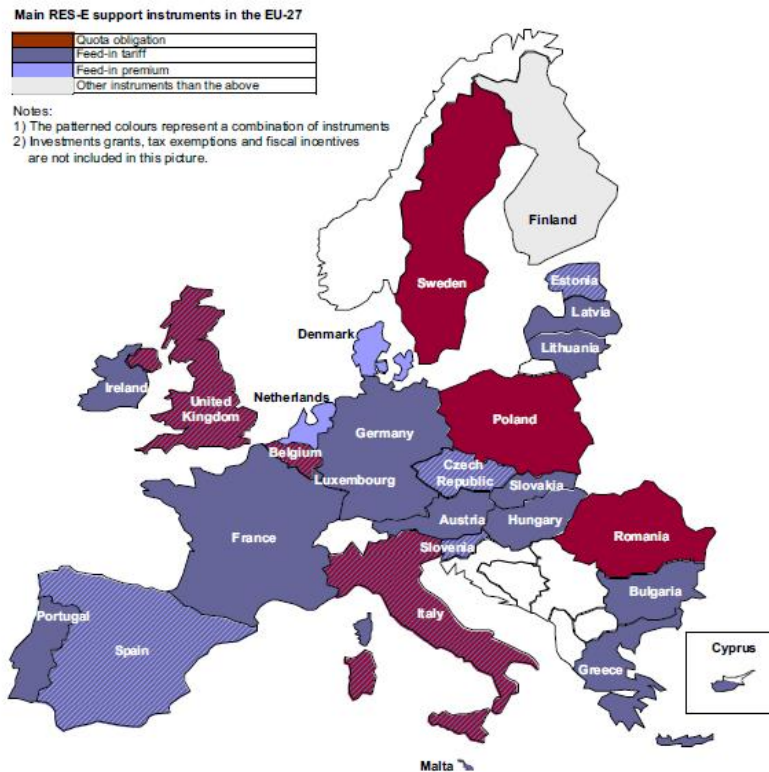


Figure 4. Main Renewable Energy support schemes in the EU-27 countries [Klessmann et al, 2011].

From the literature [Klessmann et al (2011): RE-SHAPING project], a number of barriers (not only legislative or business related) for smart energy systems were also identified, summarized in figure 5 below.

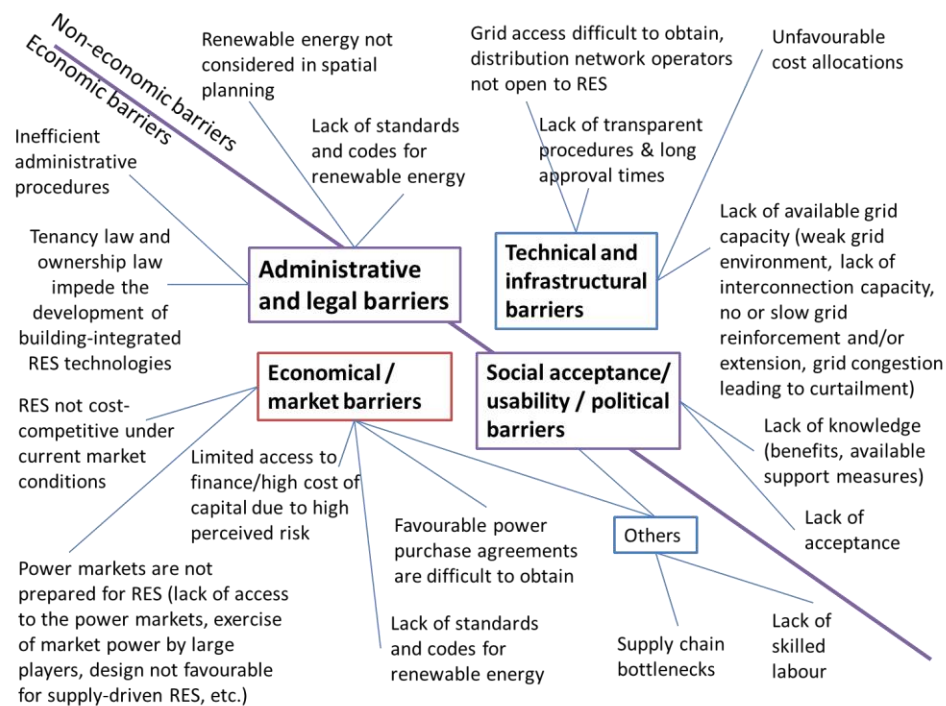


Figure 5: Main barriers of renewable energy systems [modified from Klessmann et al (2011)]

Barriers have also a close relation to the risks of the projects. Kleissmann et al (2011) state that reduction or removal of the risks of the project is one significant issue when breaking down the financial barriers. One of the reasons is that **reducing risks reduces the costs of capital**. This is why feed-in tariffs, (which minimize revenue risks for the renewable energy producer) tend to result in the lowest specific consumer costs (per €/MWh of new renewable energy) of all European support schemes for renewable energy sources, since the pay-back time (for producer) is shortened by subsidies

**A Finnish study** [Immonen, 2006] used risk allocation tables, **listing a number of risks related to services** offered to the Kaivomestari high school, sport and swimming hall and some community spaces. The tables were used to assess how significant each risk would be, and how the risks should be shared between the stakeholders. The study concludes that **the method is appropriate for carrying out a risk analysis**, helping e.g. contract negotiations by understanding the interests and risks of all stakeholders.

## 1. Introduction

The 'E-Hub: Energy-Hub for residential and commercial districts and transport' project is funded under the specific programme "Cooperation" in the FP7 framework initiative "Energy efficient Buildings (EeB, FP7-2010-NMP-ENV-ENERGY-ICT-EeB) with the aim of developing a concept able to utilise the full potential of renewable energies, covering up to 100% of the energy demand at district level. The scope is to build up the E-Hub system and to develop technologies that are necessary to realise the system, to develop business models in order to overcome institutional and financial barriers, and to perform a feasibility study/case study consecutively to be applied in real life situation. The aim of the E-Hub project is to develop a concept able to implement/utilise the large share of renewable energies, similar to an energy station, in which energy and information streams are interconnected/converted into each other and/or stored.

The aim of this deliverable report is to **describe the market needs and business models** (concept, content, earning logics, financing models and risk management) in the area of district level energy services. Also the overview of **barriers and incentives** for district energy concepts is presented. Moreover, the possibilities for new ways of making business and offering energy services are studied. The state-of-the-art analysis was done by literature reviews, questionnaires and interviews.

### 1.1. Background of the work

The goal of work package 6 is to provide the basic business information to define alternative energy service concepts and their business models as well as the ICT solution supporting their implementation. In addition, a specific task is included to contribute to the deployment and implementation of the results generated in the other tasks in WP1...WP5. The work is organised in the following tasks:

Task 6.1: State-of-the-art of market needs, business models and stakeholders in energy networks

Task 6.2: Financial support for energy efficient districts

Task 6.3: ICT enabled energy services

Task 6.4: Implementation of business strategies in demonstrations and feasibility studies

The target of **task 6.1 was to study the state-of-the-art of market needs and business and service models** in the area of district level energy services and business. The market needs in this context means the needs of the different stakeholders (i.e. private or companies end users, service providers, real estate developers, public authorities or policy makers). The state-of-the-art means in this context the current and near future situation. The clear definition of what is the state-of-the-art or current practise of used models and what is future or new model is not possible. The 'state-of-the-art' and 'best practises' depend strongly on the country; some model is currently used in some country but will be future solution in the other country.

The task 6.1 included following aspects:

- Market analysis and need for energy services
- Analysis of stakeholders in energy networks; business ideas and driving forces of stakeholders, decision making processes and workflow of implementation of district energy network (in different countries)
- Alternative business models for energy services; analysis of current business models and new energy-hub service network based models; Incentives and barriers for the business models.
- Energy service concepts and content
- Earning logics in business networks
- Financial models for energy services, e.g. PPP models
- Risk management methods and mitigation in district energy hub business.

The work in task 6.1 is organised in 3 subtasks:

- State-of-the art of markets and business models
- Business and service models for e-Hub systems
- Methods for identification of potential non-technical barriers and risks for new business and service models

The terminology used in this report is described in the background paper of WP6 [Kohonen et al, 2011], presenting a common understanding of topic services, business models and value chains; as well as the description of terminology. A summary of key terminology is presented in Annex A.

The work is continued in task 6.2 by utilising the selected innovative concepts when studying new approaches for sourcing and financing E-HUB district energy solutions. In addition, the business models and non-technical barriers identified in task 6.1 will be applied to the different case studies respectively in Subtask 6.4.2 'Elaboration business model for each case study' and Subtask 6.4.4 'Non-technical barriers and practical guidelines for each case study'.

Technical features utilised in task 6.4 (FB1-FB5) are derived from the simulations performed in task 4.5.

## 2. State-of-the art of markets and business models

### 2.1. Overview of the study

An analysis of the markets and needs of energy services was performed in the first subtask, including an overview of the stakeholders in different types of energy networks. The services needed by different stakeholders are analysed and business ideas and driving forces for different stakeholders are described. The state-of-the-art analysis is done by literature reviews, questionnaires and interviews. The work is based on the background paper of WP6 [Kohonen et al, 2011], which gave a common understanding of topic services, business models and value chains; as well as the description of terminology. A summary of the key terminology is also presented in Annex A.

The main conclusions of the background paper (Kohonen et al, 2011) are as follows. “The main advantage of the smart energy concept is seen to be its **ability to optimize energy usage in a more holistic way than smart grids and its higher energy efficiency in local areas**. The benefits of smart solutions include improved reliability and security of the energy system, maximized energy efficiency and minimized environmental impact for example due to increased renewable energy sources and reduced need for fossil fuels. Regulation of electricity markets in EU has changed a lot due to liberalization and aim towards single internal energy market. Liberalization has meant decoupling of suppliers from monopoly activities in such way that consumers can choose which supplier to use, suppliers can produce electricity in all EU countries and open access is enabled for all participants. Regulation can have a major impact on the business possibilities for smart solutions. Current regulatory frameworks are diverse but it is argued that none of them clearly incentivize for investments in smartening the grids or more generally in smart energy solutions. Owing to multitudinous stakeholders and actors identified in smart energy business it's more logical to discuss the value creation models than a business model of a single company in the network. Smart energy solutions enable new business opportunities like services, but it is still an open question, which stakeholders will develop them. New participants such as facilitators and financial organizations might also emerge to help in the development of smart energy districts, solutions and services.

In the beginning, the common method for analysis of stakeholders was developed, e.g. approach of making a mind map of stakeholders (Figure 1).

The overview of present services and business models in existing districts was compiled through a literature review, which target was to collect the results of present research projects (EU & national projects) and specific case districts the research consortium has been involved in or has got information on. This analysis includes the description of the service and business ideas, analysis of stakeholders in energy networks, business ideas and driving forces of stakeholders, decision making processes and workflow of implementation of district energy network (in different countries). The existing concepts of the services are described. The incentives and barriers for the business models and services are also identified.

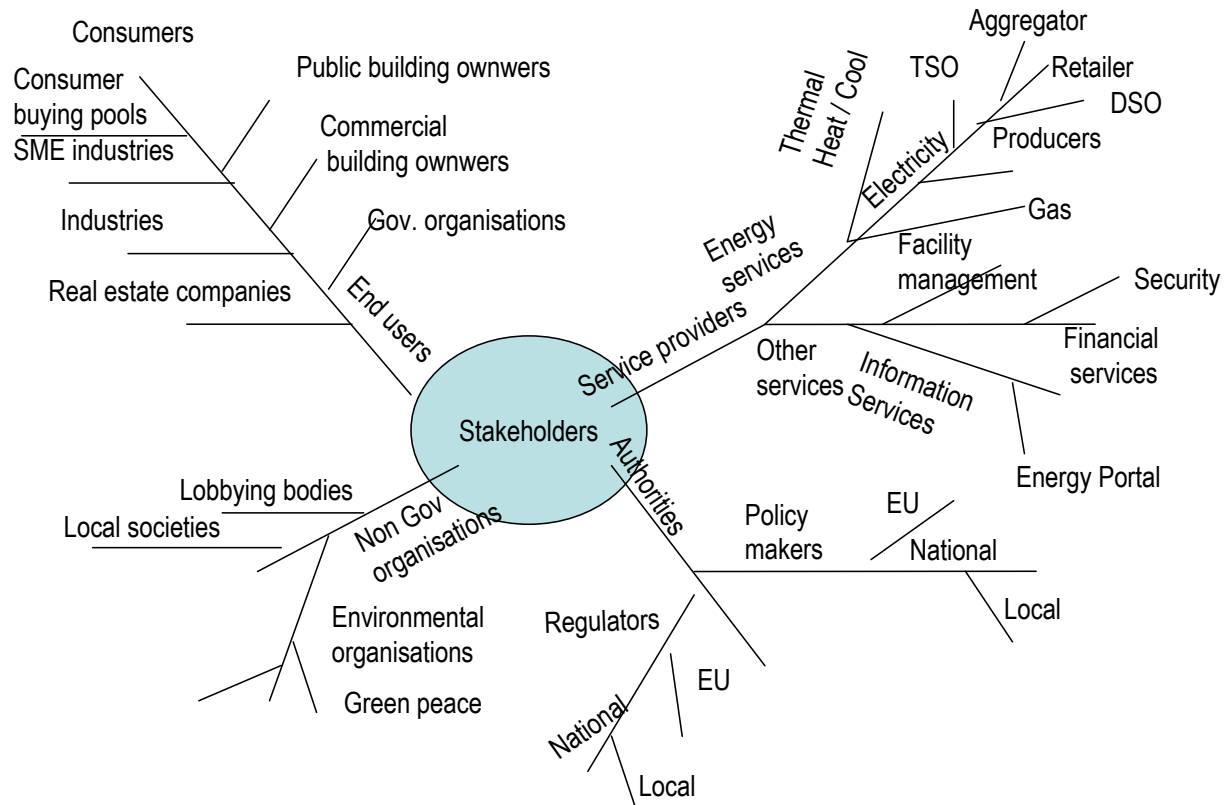


Figure 1. Mind map of possible stakeholders (Kohonen 2011).

In addition, an overview of existing legislations, incentives and barriers for energy business and systems was done by a literature review.

After collecting information about existing case studies, a questionnaire study was planned and executed to complete the results. A broad web based questionnaire was executed with Digium Enterprise application, which allowed to add the translation of questions to partner languages; thus easing both the answering to the questionnaire and summarising the results. Moreover, also country specific questionnaires and interviews were done in order to get more specific information about new business opportunities and models related to smart energy services.

In the end, a summary of literature and questionnaire research is presented.

## 2.2. General concepts of contracting models and models for partnership in projects

This section describes the general concepts of arranging the responsibilities and tasks during life-cycle of the projects. The public private partnership (PPP) model and different variations are described. The energy service related concepts EPC (energy performance contracting), ESCO (energy service company) and specific case ESCO having interaction with distribution operator are described.

Based on the E-HUB cases identified by the partners (more in details in chapter 2.3) PPP models seem to be the most frequent business model in E-HUB type projects. Thus alternative PPP models are introduced more in details.

## PPP – Public Private Partnership

The term PPP (public private partnership) covers several more specified models which partnerships between the public and private sector. These models are, for example: DBFO, BOO, BOT, BOOT, BTO, BRT, and BLT (Gallimore et al., 1997). These abbreviations consist of words and word parts like design, build, finance, own, operate, lease, rehabilitate, rent, and transfer. The common denominator of all these models is that the private sector partners have the responsibility for at least designing, building, and operating a project-facility. All these models are in common use and each project form has its individual character for instance, regarding to proactive law and risk management. [Tieva, 2009]

The Design Build Finance Operate (DBFO) model is a form of Public-Private Partnership (PPP). Design-Build-Finance-Operate (DBFO) is a procurement method where a public sector client acquires (purchases) an asset-based service from a private sector service provider. In a DBFO project, the private sector is responsible for providing a service by means of designing, building, financing and operating the project asset for the contract period, which can be up to four decades. It is expected that the financial incentives used by the client and the increased duration and scope of the private sector involvement will improve the economic efficiency of public procurement. [Lahdenperä, 2003]

Partnership model types are:

- BLT Build Lease Transfer
- BOO Build Own Operate
- BOOT Build Own Operate Transfer
- BOT Build Operate Transfer
- BRT Build Rent transfer
- D&B Design and Build
- DBFO Design Build Finance Operate
- PFI Private Finance Initiative
- PPP Public Private Partnership

A partnership mind-set is essential in PPP projects. A client and a project company form the main contractual relationship in terms of PPP projects. In addition to this, for example, a project company has several contracts with subcontractors. These partnerships are complex contractual relationships in which trust plays a big role. Co-operation requires constant care in the form of communication and reciprocal trust to strengthen it. Trust is achieved by the companies and public sector representatives binding themselves to shared goals. [Tieva, 2009]

The different selected options e.g. size and scope, project tasks and payment model have been used for characterising the type of the life cycle-projects in building services (Heimonen2, 2007), Figure 2. This approach gives an indication there is a large variety of the concepts of arranging the life-cycle models for the project and the models selected are very case specific.

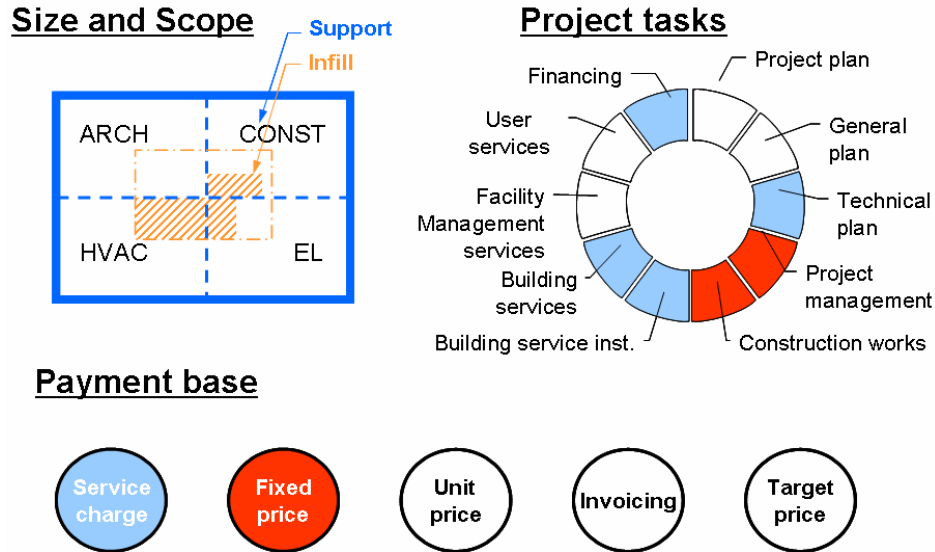


Figure 2. Framework of selection of life-cycle models for building services (Heimonen, 2007).

A very wide variety of method types fall under the concept of life cycle models, depending on the service entity offered and the way the provision of a service is organized. Procurement of building services with life cycle models differs from traditional procurement methods in various aspects [Zhang 2001]. To begin with, including the responsibility for planning, building, and building services in one contract offers better possibilities when striving towards cost-effective solutions and services [Eaton 2006]. These effective mechanisms can be described as the common effect of the following basic solutions [Lahdenperä, 2005; Rintala, 2004]:

- **Combining tasks.** In traditional methods, the client uses various contracts in obtaining the building services during the building's lifespan. Then, it is difficult to make the objectives of all parties meet, and often the aims of an individual party override the potential overall best for the project and the customer. By combining these tasks, service providers have a chance to remove operational borders between different actors and to develop the service entity in several different ways in the long term.
- **Goal-oriented thinking.** By defining the client's requirements and focusing on the functionality of the building services, the service providers obtain greater possibilities in choosing solutions and preparing service concepts than with traditional methods in which the client defines the technical requirements and solutions. This approach enables and encourages the service provider to provide the services in an economical way for the life cycle and to develop service-related innovations. The output specification gives the service providers increased flexibility to innovate in developing their service provision solutions for the project. This way, the client's goals become the leading idea driving the implementation of the entire project
- **Procurement method.** Procurement methods are used to ensure a good price-quality ratio for the building service acquired as the client may choose from various offers and select the best one. By using competition, it is possible to utilize a significant amount of the potential that is based on combining the building services in planning, construction and use of the building and that has been made possible by, for example, concentrating on determining the requirements at the service level.
- **Risk transfer.** In the life cycle model, the client transfers several risks to the chosen service provider. Some of the risks are shared between the client and the service provider (Akintoye 2003). In principle, the risk lies with the party with the best prerequisites to handle it. With appropriate risk transfer, the client creates incentives for the service provider in developing technical solutions and services.



- **Quality- and output-based service charges.** In life cycle models, the service provider's payment bases are usually not totally fixed, as the sum depends in part on the operational service level. The use of output-based specifications ensures that the client pays only for the provision of a pre-defined service. In addition, these mechanisms create incentives for the service provider to minimize the life cycle costs.
- **Long-term contract.** Mainly, the contractual relationships in life cycle models last for several years. A long-term contract enables the risk transfer and the functionality of the service charges. Moreover, long-term contractual relationships are used to seek a service provider that provides service and maintenance of building systems and is offered a chance to develop building services and integrate the data yielded in planning and building the systems into the operations in the operational stage.

Life cycle services broaden and lengthen the responsibility of the service provider as regards the functionality and maintenance of the target. For planning business also, this offers a new perspective. Life cycle services influence the business relationships between companies. The responsibility for the operational functionality of building technical systems and services forces each party to assess also from the economical viewpoint those factors and risks that are related in depth in the tendering stage when pricing the life cycle service.

Examples of applicable PPP schemes are presented in the EcoGrad project, which was envisioned for the city of St. Petersburg, Russia. The infrastructural solutions of the EcoGrad concept (including energy, waste, water, sewers, transportation, etc.) were based on new technologies and new business models, to which public-private-partnership schemes were naturally applicable. The use of public-private-partnership schemes was foreseen to help to cut the costs. The most widespread schemes as presented are shown in Figure 3. [Nystedt et al, 2010].

<b>Supply and management contracts</b>	Supply or service contracts
	Maintenance management
	Operational management
<b>Turnkey -projects</b>	
<b>Lease</b>	Lease
	Affemage
<b>Concessions</b>	Franchise
	BOT –type contracts
<b>Private ownership of assets</b>	Build-own-operate(-transfer)
	Private finance initiative
	Diversityre by licence or sale

Figure 3: Public Private Partnership schemes of various types [Nystedt et al, 2010].

The public-private-partnership models were considered to support the solutions proposed in the EcoGrad project. The solutions were subdivided into five sections: energy supply, waste disposal, water supply and

sewers, transportation and ICT. Acceptable public-private-partnership schemes are outlined for each of these sections. [Nystedt et al, 2010].

As an example, energy supply to the pilot PPP project was based on decentralized energy production using renewable sources. A good scheme for this was considered to be FBOOT – Finance, Build, Own, Operate, Transfer. A private operator designs, brings in the money, builds, owns and operates the energy supply system for a certain number of years, normally 20 to 25. Investment and operational costs are covered by subscription fees. The private operator undertakes the production of energy and its transfer to end users, buying deficient amounts of it from a state-owned company (SOC-1), tuning and servicing the grid and maintaining the necessary infrastructure. The holder of the network undertakes purchasing excessively produced electricity, heat and chilling energy and affording the necessary reserve facilities for a certain period of time. After the expiration of the term, the holder of the grid becomes the owner of the whole system. [Nystedt et al, 2010].

## EPC and ESCO

Energy performance contracting (EPC) is model in which the service is defined in the level of performance. The client is buying the energy performance. An energy service company (ESCO) is a company which delivers energy services, assumes financial risk relative to energy projects and further is paid according to the extent of realised energy savings. In an ESCO project the energy provider optimises the consumer's energy consumption through application of more energy-efficient technologies and by optimising the energy consumption, primarily with respect to heating and lighting [COWI 2008].

The EU-directive on energy and end-use efficiency defines an ESCO:

*"a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria;" [2006/32/EC, Art. 3.1.]*

ESCO involves two key features. First, that the company assumes some extent of financial risk. Second, that the ESCO's payment is based on the extent of realized energy savings/improvements. These features create strong incentives for the ESCO to implement optimal energy solutions because the business model is typically based on a 'no cure no pay' basis. Having provider finance at risk in this way can be expected to create strong incentives for innovation and effective energy management. [COWI, 2008]

According to the status report of Energy Service Companies market in Europe published by European Commission DG Joint Research Centre in 2010 (EC DG JRC 2010), the ESCO related services may include the following:

**Energy Service Company (ESCO)** can be defined as "a natural or legal person that delivers energy services and/or energy efficiency improvements measures in a user's facility or premises, and accepts some degree of financial risk in doing so". The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other performance criteria;

**Energy Performance Contracting (EPC)** is defined as a contractual arrangement between the beneficiary and the provider (usually an ESCO) of an energy efficiency improvement measure, where investments in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement.

**Third-Party Financing (TPF)** is defined as a contractual agreement involving a third party in addition to the energy service provider and the beneficiary of the energy efficiency improvement measure that provides the capital for that measure and charges the beneficiary a fee equivalent to a part of the energy savings achieved as a result of the energy efficiency improvement measure. That third party may or may not be an ESCO.

Additionally, in contrast to ESCO, 'Energy Service Provider Companies' (ESPCs) are natural or legal persons that provide a service for a fixed fee or as added value to the supply of equipment or energy. It is

also highlighted that often the full cost of the energy services is recovered in fee, and the ESPC does not assume any (technical or financial) risk in case of underperformance (ESPCs are paid a fee for their advice/service, not for the end result). Furthermore, in contract to EPC, 'Delivery Contracting' (DC also known as Supply Contracting, Energy Supply Contracting or Contract Energy Management (CEM)) is focused on the supply of a set of energy services mainly through outsourcing the energy supply (eg: heating, lighting etc.) And additionally, Built-Own-Operate-Transfer (BOOT) contracts are funding a model, which involves an organisation, consortium designing, building, funding, owning and operating the scheme for a defined period of time and then transferring this ownership to an agreed party. [EC DG JRC 2010]

Currently, ESCO is being used at EU level for standardisation activities; however in EU, several common barriers (or risks) were identified [EC DG JRC 2010]:

- Legislative framework, including public procurement rules
- Low and fluctuating energy prices
- Lack of reliable energy prices
- Lack of reliable energy consumption data
- Financial crises and economic downturn
- Real and perceived high business and technical risks
- Mistrust in ESCO model both from customers and from financing institutions
- Collaboration, commitment and cultural issues

Study by Boait (2009) presented energy services in the following three categories of business-to-business ESCOs, Retail energy suppliers and the Local ESCOs in the UK:

**Business-to-business** ESCOs usually are subsidiaries of large international control companies. Oil companies or utilities, that offer comprehensive energy services targeted at the medium and large scale businesses and public sector organisations. In a detailed study by Sorrell (2007), summarises energy service contracting as a viable 'where the expected reduction in the production cost of supplying energy services can more than offset the transaction cost of negotiating and managing the relationship with the energy provider'. The reduction in the production costs arises from the measures provided by the ESCOs such as CHP, heat pumps and heat networks meeting the requirement of customers comfort at lowest cost than their existing facilities and contracts of supply of kWh. The transaction cost in this case is driven by Assets specify, task complexity, competitiveness of the markets which the transaction occurs and the Institutional context. The institutional context refers to the existence of industry wide measures that reduce risk for both parties, such as standardised specifications, procurement protocols and contract etc. [Boait, 2009].

**Retail energy suppliers** majorly include retail gas and electricity suppliers. They offer services such as maintenance contracts for a fixed fee commit to rectify all faults in a domestic heating system within a specified time period, and home energy assessments etc. Boait (2009) presented the reasons on why these fragmentary offers are not bundled into proper energy services:-

- Consumer right to switch gas and electricity suppliers at short notices deters inclusion of long term investment in the same contract.
- Obvious risks to suppliers from reckless behaviour by customers
- The absence of strong commercial incentive

**Local ESCOs** as the third group arising from local authority or community initiatives operating in a restricted area (often PPP). In case of possible development of local ESCO's, innovation in CHP and unbundling of electricity distribution has been noted by Boait, 2009, where contract between distributed network operator (DNO) and the ESCO should include:

- The geographic coverage of the unbundled network
- The expected electrical peak load from the ESCO's customers that are within the coverage area (the peak load)
- The electrical load from ESCO's customers that will always be supplied by the ESCO's generators within the coverage area (the carrier load)

These proposed changes are meant to ensure that local ESCO's are potentially economically viable wherever there is a suitable concentration of thermal and electrical load, and a supply of biomass or waste. Also the local ESCO's will have an economic interest in increasing the ratio of carried load relative to peak load [Boait, 2009]. It was also argued that technical and commercial innovations are needed for a strong energy service industry which may also require regulatory intervention.

There is an effect on distribution network regulation on local ESCO: If an ESCO supplies electricity to its customers from its own local generation, it should only have to pay for the use of that part of the electricity distribution network that is actually conveying the locally generated electricity to them. Thus, a new form of electricity network charge could be adopted, reflecting the actual cost of this local distribution. The ownership of networks would remain unchanged, but the DNO would charge the costs through a new local use tariff. The same model could also be applied to gas, heating and cooling networks as well. If these local use tariffs are suitably framed, they will offer the opportunity for DNOs to gain financially from additional utilisation of a given set of network assets. This should incentivise DNOs in both the electricity and gas sectors to innovate in network management so that the maximum amount of local use can be accommodated. [Boait, 2009]

The absence of commercial incentives was noted as the most significant constraint in the development of energy services for retail suppliers. However, technology implementation and upgrading existing systems such as CHP, efficiency saving from heat pumps, availability of feed-in tariffs for renewable micro-generators, rising carbon prices and regulatory incentives will offer better opportunities. [Boait, 2009]

The suggested recommendations for a further market development of ESCO by EC DG JRC (2010) include, among others, the following:

- Focused policy support and supportive policy frameworks: A favourable policy framework can shorten the payback time of energy efficiency investment and raise the awareness of energy efficiency measures, lowering the investment risk. Improving the legal basis for the removal of specific barriers has been shown to affect the perceived risks of contractual arrangements. For example, in the Czech Republic the law supports the right of an ESCO to collect payment related to their customers' energy savings. In Hungary, local governments that have a contract with an ESCO can 'freeze' their energy costs in the budget. In contrast, in some countries the legal framework does not allow municipalities to retain the savings derived from implementing energy efficiency projects.
- Project bundling: PPP are encouraged for successful project bundling strategies. Examples seen in Italy presented the public-private ESCO consortia where the public party is responsible for the aggregation of demand, for guaranteeing and implementing the energy saving measure(s) and for the compensation for the risk of financial losses
- Facilitating the access to appropriate forms of financing: A guarantee scheme or other risk mitigating tools may be appropriate when the financing sector perceives that the risk of ESCO projects is too high. Where ESCOs' equity is insufficient to comply with the minimum equity requirement, a complementary instrument is needed, such as subordinated debt that can substitute and reduce the amount of senior debt and close an existing equity gap.
- Establishment of an ESCO association and the collaboration with national energy agencies: Such an association could organize workshops and knowledge sharing events with ESCOs, potential clients (municipal representatives, facility managers, etc) and financial institutions in order to increase the knowledge of how ESCOs engage in projects and what benefits can ESCOs bring to project management from a risk reduction, financial and environmental perspective.

### 2.3. Description of the 'E-HUB' case studies in partner countries

The typical district energy projects or 'E-HUB' case studies were analysed in the study. The basic data of the cases in partners' countries was collected using common fact sheet presented in Annex B. The descriptions of the cases are presented in Annex C. The summary of the cases is described in Table 1.

Table 1. Summary of cases: The distribution of case per scale and technological scope.

Type	Number of cases
<b>Building level case</b>	5
<b>Building level case + ESCO business model</b>	1
<b>Building level case + extended service scope</b>	1
<b>City level cases 2 and 1 nationwide</b>	3
<b>District scale cases</b>	15
<b>Ordinary District Heating /Cooling cases</b>	3
<b>Ordinary DH/C cases + PPP(P) business model</b>	2
<b>District Energy System (a micro CHP based system)</b>	1
<b>District scale + Integrated Energy System , ie. E-HUB solution</b>	6
<b>Unclear</b>	3

Cases are derived from 20 projects, as identified by Partners (see annex B). The most interesting cases (i.e. relevance to the E-HUB project) having integrated energy systems and service concepts included in the cases are presented in Table 2. The reported case indicates clearly that the maturity, penetration and application of different energy technologies vary a lot country by country. For instance district heating and cooling are business as usual case in the northern Europe while still very rare in the southern European countries.

Table 2. Service, business models and technology scope in the district energy projects

Project	Status	Scale	Services	Business model	Technology scope
<b>Linear</b>	On-going demoproject	Existing residential area	Active demand, dynamic pricing	N.A.	Flexible energy resources at consumer premises
<b>Power Matching City</b>	Operational	25 family houses	Electricity, domestic hot water	PPP	MicroCHP, HP, PV, Wind turbines, electric storage, power matching technologies
<b>Couperus smart grid</b>	Construction	288 flats + office	N.A.	PPP, test bed	Smart grid, H/C storage
<b>Polo Energie</b>	Operation / development	179 GWh/a	Heat, cool, maintenance	PPP	W2E, geothermal, solar
<b>Village of Laas South Tirol</b>	Operation	5.5.-6.5. MW <sub>H</sub>	Heat, maintenance	PPP+ cooperative	Biomass, biodiesel
<b>Alessandria (Italy)</b>	Operation	EcoVillage of 299+101+50 dwellings	Heat/Cool/ Electricity	N.A.	Biomass trigeneration, solar thermal, PV plant

In order to further analyse the E-HUB case listed in table 2, their current and new business and financial models, potential new smart energy services, financial, legal and contractual aspects and their costs and benefits, local interviews and workshops were organised (more in details in Chapter 3).

Even if the number of identified project cases was relatively low, there are a lot of research and piloting activities on-going in Europe. Some district case projects relevant to the E-HUB project are listed and shortly described below:

- **SAVE Energy**: aims to transform the energy consumption behavior of public building users by applying leading edge ICT-based solutions, specifically Real-Time Information on energy consumption
- **ENERSip**: Service oriented emonitoring, real time info > open information platform
- **iEnergy**: intelligent energy source management and consumption monitoring device
- **MiDDai** : an innovative Power Management System
- **Smart@ Home**: is aimed to boost the development of integrated and convergent products and services which will be easy to install and use, by creating platforms capable of supporting the management of the most important functions in a house,
- **E3SoHo** : Providing tenants with feedback on consumption and offering personalized advice for improving their energy efficiency, Monitoring and transmitting consumption data to Energy Services Companies which can enable real-time energy audits in order to perform more accurate refurbishment activities as well as maintenance operations
- The **SAVE ENERGY** project aims to transform the energy consumption behavior of public building users by applying leading edge ICT-based solutions, specifically Real-Time Information on energy consumption and Serious Games, in an innovative user-driven Living Lab approach implemented in 5 pilots; Helsinki, Leiden, Lisbon, Luleå and Manchester.
- The **iEnergy** project develops an intelligent energy source management and consumption monitoring device, which analyses, in real time, the state of consumption of the monitored site, the available energy sources, their respective costs, and foreseen energy needs, making decisions on the optimal mix that minimizes the site's energy bill. The system is capable of making decisions on the ideal time to activate a co-generation battery, when to defer consumption to more convenient hours (e.g. fridge equipments), or when to resort to the primary energy provider, if the energy need cannot be met by locally generated or if the operator's tariff is lower than the local generation cost.
- **EcoGrid EU**: The demonstration will take place on the Danish island Bornholm with more than 50 % electricity consumption from renewable energy production. Of a total of 28.000 customers on Bornholm, approximately 2000 residential consumers will participate with flexible demand response to real-time price signals. A real-time market concept will be developed to give small end-users of electricity and distributed renewable energy sources new options (and potential economic benefits) for offering TSO's additional balancing and ancillary services.
- **The MiDDas**: concept was to develop an innovative Power Management System, which when the demand on the Grid is low stores accessible power that can be used later to allow flexible disconnection of various appliances from the Grid when the demand is high.

Even if no cases were reported from Germany there are several district energy projects in Germany, e.g. German eEnergy projects, where the six prize-winners are (Federal Ministry of Economics and Technology (BMWi) of Germany : E-Energy ICT-based Energy System of the Future):

- E-DeMa, Ruhr area model region
- eTelligence, Cuxhaven model region
- MEREGIO, Baden model region
- Mannheim model city, Rhine-Neckar model region
- RegModHarz, Harz model region
- SmartW@TTS, Aachen model region

The six other projects nominated are

- deCide, Dresden model region
- EnTradelT, Berlin model region
- EquiKom, Nuremberg model region
- OPTIFLOW, Allgäu model region
- SPREE, Cologne model region
- Uckermark virtual power plant, Uckermark model regio

## Summary and evaluation of E-HUB case studies

In order to better understand the some basic information of projects relevant in the E-HUB scope were collected by the partners. Altogether 20 projects were identified by the partners (Annex B). Even if the number of identified project cases were relatively low, there are a lot of research and piloting activities on-going in Europe.

The scope of identified E-HUB projects varied from building level cases to nationwide energy systems. Further the scope of services offered was rather traditional- mainly heating and cooling and in some cases management services were offered. In contrary the technology scope varied: solar, biomass, geothermal energy, waste to energy, heat pumps, tri- gen plants, wind turbines, micro CHP:s as energy generators.

The most common business model was the PPP model that indicates that the public sector has an important role in introducing new energy service solutions. There were a case (Italy) were co-operatives participated to energy production in the role of biofuel suppliers.

The reported case indicates clearly that the maturity, penetration and application of different energy technologies vary a lot country by country. For instance district heating and cooling solutions are “business as usual” case in the northern Europe while still very rare in the southern European countries. .

Some of the identified district energy projects whose service offering, business models and technology scope were selected for further analysis. The analysis of the existing and alternative new energy service concepts and content was performed by workshops and interviews, which results are reported in Chapter 3.2.

## 2.4. Existing legislations, incentives and barriers for energy business and systems

### Legislation

Production of electricity or gas on the distribution grids by small consumers, demand side management, demand response and ESCOs, working in this area, are relatively new. They came into being due to technical progress, such as the possibility to produce energy on a small scale with solar panels or biogas, and the development of ICT, which enables energy management of small scale production and demand. Unfortunately, viable business models for these new activities or services can be hampered by legal rules. Most energy legislation (EU and national) with respect to the organization of the Gas and Electricity sector stems from the period of liberalization and privatization in the 1970s and 1980s. This legislation was meant to introduce competition in the electricity and the gas sector, which barely existed, and to facilitate privatization of public owned companies. At that time, electricity and gas were produced with large production plants, at high voltage grids, and transported to passive users on the distribution grids, users who could not influence their time of use nor produce themselves. Then the newly designed legal system reflected those circumstances. The current developments in small local production and active participation from consumers, such as demand side management, were not foreseen and were hence not taken into account.

Various provisions in the law, which could be justified when the law was enacted, may now impede the access to the market or viable business models for consumers, producers and ESCOs at the local level.

Energy Law in the Member State varies. At the European level, the activities of ESCO's are subject to obligations laid down in European Energy Law (Electricity Law and Gas Law). The Third Energy Package, including Directive 2003/54/EC concerning common rules for the internal market in electricity and Directive 2003/55/EC concerning common rules for the internal market in natural gas, is of special importance. These directives establish common rules for the generation, transmission, distribution and supply of electricity and natural gas. In addition, in the directive 2002/91/EC on the energy performance of buildings, ESCOs are included. For the rest, Member States are free to enact their own national legislation.

This section discusses three relevant issues with respect to ESCOs: the *ability for consumers to change supplier* in all circumstances, *transport tariffs* and *smart energy systems*.

#### *The freedom to change supplier*

ESCOs often deliver not only energy to their customers, but they are also willing to invest on behalf of their customers, for example in energy efficiency measures or in installations for sustainable energy. Customers could pay for these investments through a long term contract, where the extra costs of the investments are included in the energy bill. Savings in the costs of energy can be used to amortize the investments in energy efficiency. However, long term contracts for the supply of energy are often hindered by law, since these are not in line with the principles, underlying its methodology.

Third party access to infrastructures, in combination with the right for consumers to change supplier underpins the legal system for gas and electricity. In order to stimulate competition between suppliers of energy, consumers have a legal right to switch supplier often at a short notice. The ability to switch supplier is supposed to impose a discipline on large or perhaps even dominant suppliers of energy and to encourage them to seek out innovations and develop service offers that will generate sustainable benefits for consumers. The right for consumers to change supplier is an essential element for the introduction of competition into a sector, where the companies traditionally had monopoly power. It also protects consumers in a concentrated market in which few companies have a large market share. In the various Member States, the freedom for consumers to change supplier may be implemented in a different way.

In the Netherlands, for example, small consumers may have a contract of indefinite duration or a contract for a specific period of time with their energy suppliers. If the contract is of indefinite duration and the customer wants to terminate the contract, he may be obliged to pay a penalty fee of 50 euro's maximum. If the contract is of a specific duration, the regulator has fixed the fines on €125 euro's, when the duration of the contract would be more than 2,5 years, €100 euro for a duration between 2 years and 2,5 years, €75 for a residual period between 1,5 and 2 years and 50 euro's for a remaining period of less than 1,5 years. These fines apply to the delivery of gas and electricity separately. So a fine can be posed on terminating a contract for the delivery of electricity and another fine for terminating the contract for the delivery of gas (Richtsnoeren 2008).

An ESCO, who wants to conclude a contract for the delivery of "comfort" for a longer period of time, for example 7 year, in order to amortize the investments the ESCO did on behalf of the consumers and to straighten out the repayments with the energy bill, risks that the consumers chooses another energy supplier in the meantime and pays the fine, as maximized in Energy Law, for ending the contract early. For the ESCO, this may be a problem since the investments in energy efficiency measures or installations are not amortized.

In that case, other arrangements should be made to make sure that the consumer pays for the part of the investments, which is not paid off. According to Boait (2009), a solution would be that, where the asset is owned by the original supplier, the incoming supplier must make a payment to acquire the asset dependent on age, condition etc; A competing ESCO could take over the whole contract, including the assets. This should be regulated in law.

An ESCO could perhaps conclude different contracts with the consumer, depending on the possibilities of national law. In that case, the supply of energy can be (contractually) separated from the other activities. The first (long term) contract concerns the investments in installations or energy efficiency measures and the other contract applies to the supply of energy.

Summarizing, under Energy Law, the conclusion of long term contracts between a supplier of energy (ESCO) and a small consumer (household or small business enterprise) is difficult. Interests of promoting competition and protecting consumers seem to be in conflict with interests of combining the services of energy supply and energy efficiency measures, as ESCOs deliver. It may be possible in individual Member States to find special solutions under contract law. If this is not possible, specific regulatory measures as mentioned above could solve this problem.



### *Tariffs for transport of energy*

Transport tariffs for electricity are also designed in an era, where electricity from large producers connected to the high voltage transmission grid was transported to passive users connected to distribution grids. Often, the costs of transport are for a large part socialized and passed on to users connected to the distribution grids. For example, in most Member States, large producers connected to high voltage transmission grids do not have to pay transport tariffs. The costs of extra investments in transmission grids, when new large producers are established and the costs of transports of their electricity, are passed on to small consumers, even in cases where they do not make use of the transmission grids. For ESCO's, this is an impediment to operate on the market. Financially, they do not have the same conditions of access to transport facilities as large producers. The costs of transport may impede the conclusion of a viable business case.

A level playing field between large companies and ESCOs is established when ESCO's would only pay for the use of the electricity grid that is actually conveying electricity to them, as already mentioned in section 2.2. The payment of only the costs of the systems, which are caused by their transports, adds to their vitality.

Local tariffs are also element of the proposed Energy Efficiency Directive, Annex XI, prescribing that network tariffs shall be cost-reflective of cost savings in networks achieved from demand side and demand response measures and distributed generation, including savings from lowering the cost of delivery or of network investment and a more optimal operation of the network.

**In the longer term, it could be important to design a new methodology of calculating transport tariffs**, a methodology which takes into account new technologies such as different forms of distributed generation and possibilities of demand side management and demand response. The costs of the infrastructures should be borne by the producers (large or small) and other users (large or small) causing these costs. According to research, there may be important savings in costs of investments in new electricity grids when intelligent local grids are used to balance supply and demand at the local level and existing grids are used efficiently (Ault 2008, Blom et. al. 2012). Transport tariffs should reward an efficient use of the infrastructures. Local tariffs and dynamic pricing of networks are suitable, like time-of-use tariffs, critical peak pricing, real time pricing and/or peak time rebates (see also Annex XI of the Energy Efficiency Directive). With such tariffs, ESCO's are rewarded for their efforts to balance supply and demand and to fit sustainable energy from intermittent resources into the system.

Another possibility is the unbundling of the local loop, where ESCOs can hire a certain part of the distribution grid, in analogy with telecom operators, hiring a (limited) access to the fixed telecom lines (Pollitt 2010). ESCOs, hiring a certain amount of transport capacity, have an interest in balancing demand and supply in order not to exceed the limits of their contracts. It promotes an efficient use of the grids and enlargements of the grids, which would be necessary without this balancing, may be postponed or suspended.

### *Smart energy systems*

Experiments with smart energy systems, in which ESCOs may play an important role, are important for the energy transition. In a smart energy system, production, supply and demand of energy (gas and/or electricity and/or heat and/or cooling) and the infrastructures are locally integrated, for example in a residential or industrial area. Private ownership of infrastructures and private operation of distribution grids, so that these are part of the system, is allowed under the Directive 2009/72/EC. However, under European Law, operators of distribution systems are heavily regulated, in order to guarantee third party access to those infrastructures at reasonable conditions for all users and potential users of these infrastructures (chapter VI of the Directive 2009/72/EG). **Obligations for operators of distribution systems include unbundling, regulated prices, regulated transparency and safe delivery.** Within these rules, it would be extremely difficult for ESCOs to experiment with new business models and appropriate transport tariffs in smart energy systems and at the same time follow these rules.

However, European Law provides some exceptions to those rules in order to promote smart energy systems on a local level (Pront-van Bommel 2011). Article 28 of the Directive 2009/72/EG regards the so-called closed distribution systems, especially for industrial or commercial sites in a confined area. Among others, the requirement that tariffs for access to the grids, or the methodology underlying their calculation must be approved prior to their entry into force does not apply to closed distribution systems. Under this exception, ESCOs may experiment with tariffs for access to the electricity grids. Users of such a closed distribution system always retain their right of third party access to the infrastructure. If they request so, the applicable tariffs or the methodologies underlying their calculation, shall be reviewed and approved by the regulator. Member States are allowed to include the exception of the closed distribution systems in their legal system, but they are not obliged to do so. In the UK, for example, this exception is included in the legal system (Ofgem 2012).

Another possible exception to the general rules of operating distribution grids is provided by Article 26. This concerns the obligation to unbundle the distribution system operator from other activities of a vertically integrated undertaking. When it is serving less than 100.000 connected customers or small isolated systems, a vertically integrated ESCO, is not obliged to unbundle the operation of the distribution grids from the other activities, such as supplying energy or other services (Art. 26 section 4). As is the case with closed distribution systems, Member States are not obliged to include this exception in their regulation. If they do so, their ESCOs have more possibilities to experiment with smart energy systems and to innovate the system.

## Incentives - support instruments of renewable energy sources

Smart energy services are in most cases based on utilisation of renewable energy. Thus incentives and other support instruments are important to promote E-HUB solutions and services as well.

Various market based instruments are used by the governments of EU countries to subsidise renewable energy. These can be divided into two groups: 1) investment support (capital grants, tax exemptions or reductions on the purchase of goods) and 2) operating support (price subsidies, green certificates, tender schemes and tax exemptions or reductions on the production of electricity). In general, the operation support (per produced MWh of energy) is seen to have more significance than investment support. Typically a combination of support schemes is used to realise renewable energy investments. As an example, "a common combination of support schemes is to have investments subsidies or soft loans in addition to the main support scheme, such as feed-in tariffs or quota obligations." [SEC(2008) 57]

The following support instruments are used in EU [SEC(2008) 57]:

### Quantity-based market instruments:

- Quota obligation: *"Governments impose an obligation on consumers, suppliers or producers to source a certain percentage of their electricity from renewable energy. This obligation is usually facilitated by tradable green certificates (TGC). Accordingly, renewable electricity producers sell the electricity at the market price, but can also sell green certificates, which prove the renewable source of the electricity. Suppliers prove that they reach their obligation by buying these green certificates, or they pay a penalty to the government."*
- Tendering: *"A tender is announced for the provision of a certain amount of electricity from a certain technology source, and the bidding should ensure the cheapest offer is accepted."*

### Price-based market instruments:

- Feed in tariff and premium: *"Feed-in tariffs and premiums are granted to operators of eligible domestic renewable electricity plants for the electricity they feed into the grid. The preferential, technology-specific feed-in tariffs and premiums paid to producers are regulated by the government. **Feed-in tariffs** take the form of a total price per unit of electricity paid to the producers whereas the **premiums (bonuses)** are paid to the producer on top of the electricity market price. An important difference between the feed-in tariff and the premium payment is that*

the latter introduces competition between producers in the electricity market. The cost for the grid operator is normally covered through the tariff structure. The tariff respectively the premium is normally guaranteed for a period of 10 – 20 years. In addition to the level of the tariff respectively the premium, the guaranteed duration provides a strong long term degree of certainty which lowers the market risk faced by investors. Both feed-in tariffs and premiums can be structured to encourage specific technology promotion and cost reductions (the latter through stepped reductions in tariff/premiums.)

- **Fiscal incentives, (e.g. tax exemptions or reductions):** “Producers of renewable electricity are exempted from certain taxes (e.g. carbon taxes) in order to compensate for the unfair competition they face due to external costs in the conventional energy sector.” “The effectiveness of such fiscal incentives depends on the applicable tax rate. In the Nordic countries, which apply high energy taxes, these tax exemptions can be sufficient to stimulate the use of renewable electricity; in countries with lower energy tax rates, they need to be accompanied by other measures.”

Support instruments of renewable energy sources have been gathered in EU-project called RE-SHAPING (see Table 3 and Figure 4). However, the situation changes constantly, e.g. Finland adopted the usage of feed in tariff for wind power, biogas plants and wood fuelled plants in 2011 [Motiva, 2012].

Table 3. Overview of renewable energy sources support instruments in the EU-27 (modified from Klessmann et al, 2011)

Member state	RES-Electricity support instruments							RES-Heat support instruments				main biofuels support instruments*	
	Feed in tariff	Feed in premium	Quota obligation	investment grants	Tax exemptions	Fiscal incentives	Tendering schemes	Investment grants	Tax exemptions	Financial incentives	Use obligations	Quota obligations	Tax exemptions
AT	x							x	x			x	x
BE	x		x	x	x			x	x				x
BG	x					x		x		x		x	
CY	x			x				x				x	x
CZ	x	x		x				x				x	x
DE	x					x		x		x	x	x	x
DK		x					x		x			x	x
EE	x	x				x		x		x			x
ES	x	x			x						x	x	x
FI				x	x			x				x	
FR	x						x	x	x	x		x	x
GR	x			x	x			x	x				x
HU	x			x				x					x
IE	x							x				x	x
IT	x		x						x				x
LT	x			x				x	x			x	x
LU	x			x				x				x	x
LV	x			x	x			x				x	x
MT	x			x		x		x					x

Member state	RES-Electricity support instruments							RES-Heat support instruments				main biofuels support instruments*	
NL		X			X	X	X	X	X			X	
PL			X		X	X		X				X	X
PT	X						X	X		X	X	X	X
RO			X									X	X
SE			X		X			X	X				X
SI	X	X				X		X				X	X
SK	X				X			X				X	X
UK	X		X		X			X	X			X	X

\*Transport energy from renewable energy sources: member states have focused almost entirely on biofuels in their support of RES transport fuels. Other forms of transport energy, such as biogas for gas engines and RES electricity for electric vehicles, are therefore not included in the analysis

Main RES-E support instruments in the EU-27

	Quota obligation
	Feed-in tariff
	Feed-in premium
	Other instruments than the above

Notes:

- 1) The patterned colours represent a combination of instruments
- 2) Investments grants, tax exemptions and fiscal incentives are not included in this picture.

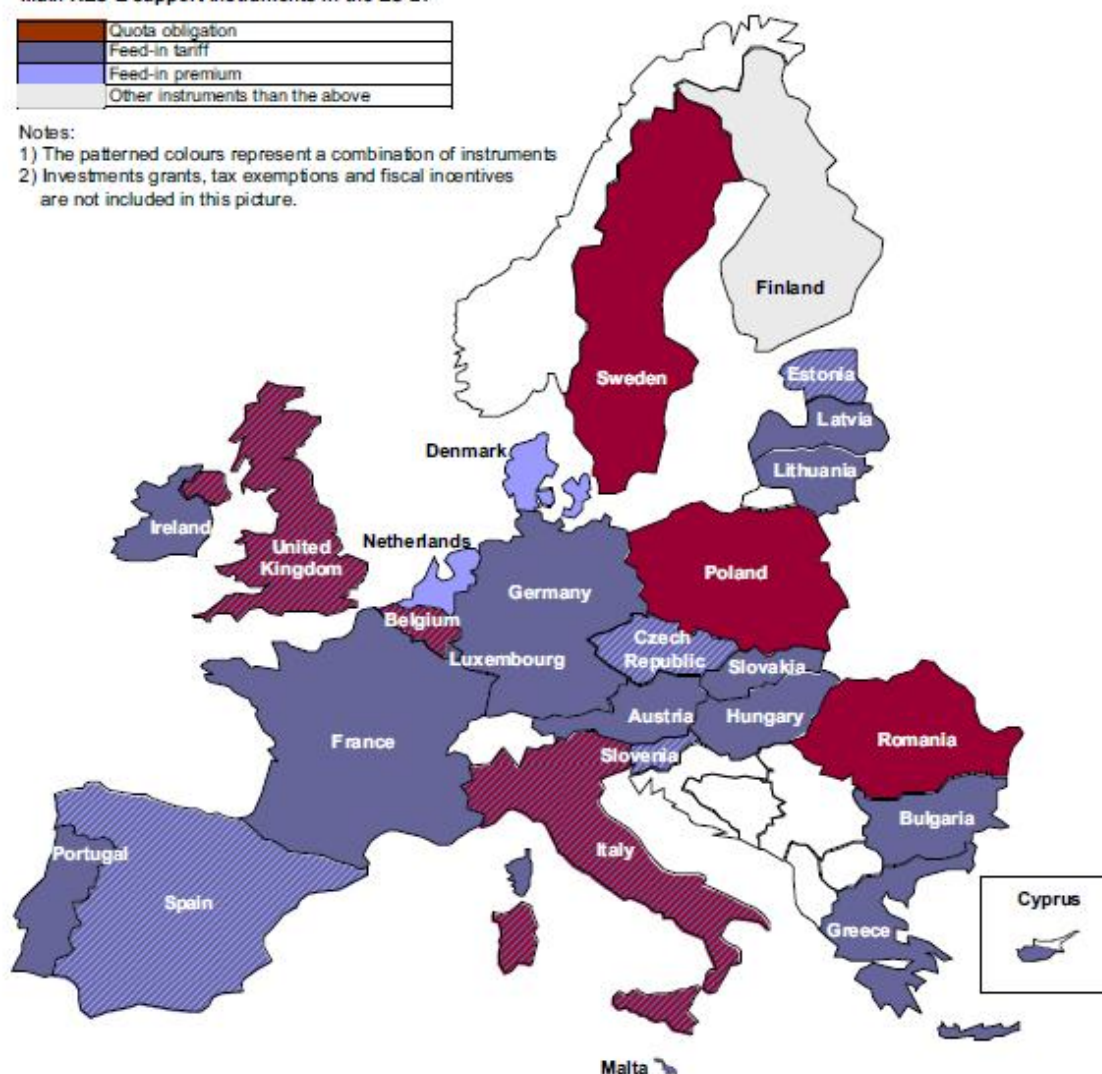


Figure 4. Main RES-E support schemes in the EU-27 countries [Klessmann et al, 2011]

Overall, the average effectiveness of support policies for heating with renewable energy sources is considerably lower than for renewable electricity. One important reason for this might be that support schemes for renewable heating are almost entirely financed by public budgets. [Klessmann et al, 2011]

## Non-technical barriers for renewable energy production

The first evaluation of the barriers for new E-HUB business and services was done through a literature review. The main barrier groups **for renewable energy systems** are presented in Figure 5. There were divided into economic and non-economic barriers, and into four categories: administrative and legal barriers, technical and infrastructural barriers, economic and market barriers and social acceptance and political barriers.

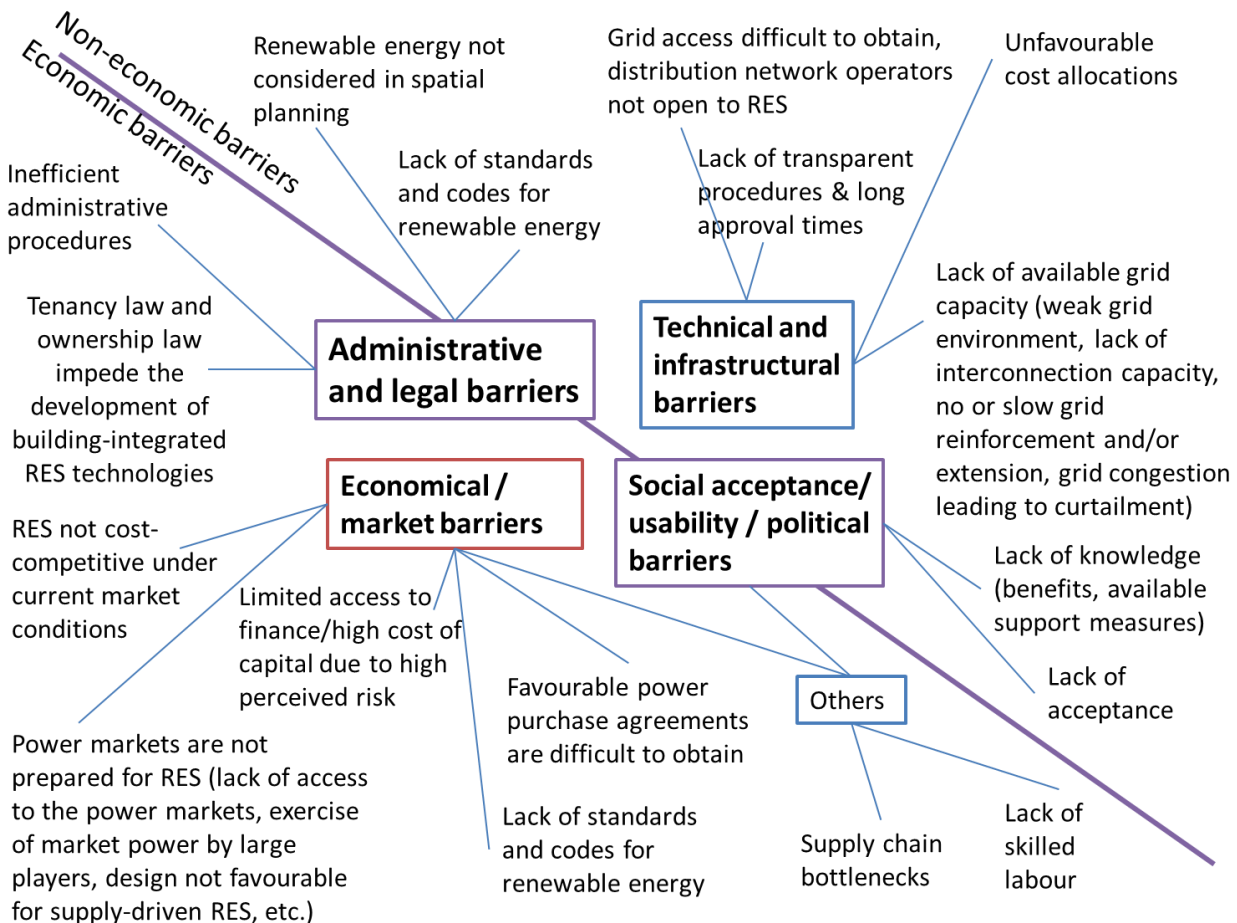


Figure 5: Main barriers of renewable energy systems [modified from Klessmann et al (2011): RE-SHAPING project]

It is argued, however, that new energy services business will overcome many traditional barriers, such as the need for a carbon price or disconnecting the profitability of an energy company from the energy volume growth. This will align the interests of many stakeholders, such as communities, end users, energy service providers and the environment. Although there are several paths to create such energy service concepts, it is noted that the property sector, e.g. housing organisations, have presumably a significant role in finding new alternative options for organising the supply of services. In this case, new service concept would be based on repackaging the consumer need as well as product and service combinations.

This can be called as **a result or need oriented service model**. Technologies needed for E-hub system exists already, but they have to be repacked in a new way, resulting in improved energy efficiency and reduced primary energy usage and emissions. [Szatow, Quezada and Lilley, 2012]

**Administrative barriers for renewable energy production** are presented in Table 4.

Unfavourable administrative framework conditions are one of the biggest barriers in almost all EU member states. (Klessmann et al; Ragwitz et al (2007))

Table 4. Administrative barriers for renewable energy production [Modified from Klessmann et al, 2011]

<b>Administrative and legal barriers</b>	<b>Options for policy response:</b>
Inefficient administrative procedures (high number of authorities involved, lack of coordination among authorities, lack of transparent procedures, long lead times, high costs for applicants etc.)	Improving and streamlining administrative procedures towards transparent and non-discriminatory processes ("one-stop shop" approach for applications, maximum response periods for authorities, clear guidelines and capacity building for civil servants, limiting administrative requirements to the relevant elements, simplified procedures for small plants, etc.)
Renewable energy not or insufficiently considered in spatial planning	Improved spatial planning rules Definition of renewable energy priority areas Information and capacity building for local authorities Participation and/or compensation options for local communities
No or insufficient standards and codes for RES equipment (specifications not well defined, not Expressed in EU/international standards, etc.)	Improvement of technical specifications and codes  Implementation of EU/international standards and certifications
Tenancy law and ownership law impede the development of building-integrated renewable energy technologies	Implementation of renewable energy use obligations Adapt tenancy and ownership law to facilitate renewable energy deployment (facilitating cost sharing, provision of energy services etc.)

**Legal barriers** (see Table 5) are one of the biggest barriers in almost all EU member states [Klessmann et al, 2011; Ragwitz et al (2007)]

Table 5. Administrative and legal barriers for renewable energy [Modified from Klessmann et al, 2011]

<b>Administrative and legal barriers</b>	<b>Options for policy response:</b>
Inefficient administrative procedures (high number of authorities involved, lack of coordination among authorities, lack of transparent procedures, long lead times, high costs for applicants etc.)	Improving and streamlining administrative procedures towards transparent and non-discriminatory processes ("one-stop shop" approach for applications, maximum response periods for authorities, clear guidelines and capacity building for civil servants, limiting administrative requirements to the relevant elements, simplified procedures for small plants, etc.)
Renewable energy not or insufficiently considered in spatial planning	Improved spatial planning rules Definition of RES priority areas Information and capacity building for local authorities Participation and/or compensation options for local communities
No or insufficient standards and codes for RES equipment (specifications not well defined, not expressed in EU/international standards, etc.)	Improvement of technical specifications and codes Implementation of EU/international standards and certifications
Tenancy law and ownership law impede the development of building-integrated RES technologies	Implementation of RES-use obligations Adapt tenancy and ownership law to facilitate RES deployment (facilitating cost sharing, provision of energy services etc.)

**Infrastructural (grid-related) barriers** (see Table 6) are a major obstacle for onshore and offshore wind; but also significant when there is the need for major transmission grid expansions. [Klessmann et al, 2011: Ragwitz et al (2007)]

Table 6. Infrastructural (grid-related) barriers for renewable energy [Modified from Klessmann et al, 2011]

<b>Grid-related barriers (mainly power grids, but also gas and district heat)</b>	<b>Options for policy response:</b>
Grid access is difficult to obtain (transmission system operators/ distribution network operators not open to renewable energy, lack of transparent procedures, long approval times, unfavourable cost allocation leading to high grid connection costs)	Guaranteed grid access Priority grid access Introduction of transparent and non-discriminatory procedures (see administrative barriers) Regulations to limit grid connection costs Close control of procedures by regulator, including sanctions for transmission system operators/ distribution network operators
Lack of available grid capacity (weak grid environment, lack of interconnection capacity, no or slow grid reinforcement and/or extension, grid congestion leading to curtailment)	Priority dispatch for RES electricity Obligation or favourable regulation for transmission system operators/ distribution network operators to enforce/extend grids Compensation for renewable energy project in case of curtailment Obligations or incentives for district heating operators Tight control of procedures by regulator Long-term grid planning strategy and incentives Harmonisation of European regulatory frameworks

**Financial/economic/market barriers** (presented in) play a significant role, especially in many new member states and for higher cost technologies (such as photovoltaic, ground source heat pumps and offshore wind energy). [Klessmann et al, 2011: Ragwitz et al (2007)]

Table 7. Financial, economic and market barriers for renewable energy [Modified from Klessmann et al, 2011]

Economic/market barrier	Options for policy response:
Renewable energy not cost-competitive under current market conditions (high capital costs, unfavourable market pricing rules, subsidies for competing fuels, long reinvestment cycles of building-integrated technologies etc.)	Support instruments that provide financial support or force market entry: Price setting policies (feed-in tariff or feed-in premium) Quantity forcing policies (quota obligations for renewable energy and biofuels) Cost reduction policies (investment subsidies, soft loans, tax reductions etc.) Phase-out subsidies for fossil fuels  Carbon pricing
Limited access to finance/high cost of capital due to high perceived risk	Support instruments that reduce market risks and provide long-term investment certainty; key features: Stability of support scheme Guaranteed revenues, e.g. support payment guaranteed for 15–20 years Limitation of price risk, e.g. feed-in tariff or floor prices for tradable green certificate or feed-in premium Financial instruments that provide low-cost capital, e.g. low-interest loans, public-private partnerships, publicly backed guarantees etc.  Public finance participation through public-private cooperation models
Favourable power purchase agreements are difficult to obtain	Guaranteed purchase Obligation for certain parties to offer long-term power purchase agreements
Power markets are not prepared for renewable energy (lack of access to the power markets, exercise of market power by large players, design not favourable for supply-driven RES, etc.)	Guaranteed purchase Priority dispatch Adjustment of power market design for the integration of intermittent renewable energy (availability of liquid intraday and balancing markets, adjustment of gate closure times, changes in pricing rules, etc.)

Kleissmann et al, 2011 also presents a method for evaluating the economic barriers:

**“Evaluation of economic barriers** by Ragwitz et al (2007) and Held et al. (2010): calculate the minimum to average generation costs per technology and country (€/MWh based on country specific data) and to compare this with the average to maximum support level provided by the relevant RES support policies in that country (€/MWh). This reveals the potential financial gap from the project developers’ perspective. This analysis for the EU-27 shows that **if support levels are below generation costs, little or no capacity growth can be observed** (with a few exceptions if investments are motivated by other than economic reasons). On the other hand, high support levels do not always lead to substantial capacity growth. The evaluation also shows that the **support levels for renewable heat generally appear to generate lower profits** than those in the renewable electricity sector, despite the low generation costs of many renewable heat energy technologies. This is one explanation for the lower average policy effectiveness in the heat sector.”



**Social acceptance barriers** (see) are ranked as lower barriers, but do play a role for (especially large scale) hydropower and wind. For example, public acceptance of biofuel deployment is one example of social acceptance barriers. [Klessmann et al, 2011; Ragwitz et al (2007)]

Table 8. Social acceptance barriers for renewable energy sources [Modified from Klessmann et al, 2011]

<b>Information and acceptance barriers</b>	<b>Options for policy response:</b>
Lack of knowledge (about benefits of renewable energy, about available support measures, etc.)	Information and training programmes Demonstration projects in public buildings Integration of renewable energy in education programmes Regulations on information and awareness raising, involving various municipalities and public institutions Publication of regular progress reports that incentivise governments to prove the success of their policies to the public
Lack of acceptance (NIMBY opposition to renewable energy plants and power lines, public concerns about sustainability of biofuels etc.)	Specific measures to address the concerns, e.g. legal facilitation of underground cables, sustainability certification for biofuels, etc. Participation and/or compensation options for local communities

**Growth related barriers** evolve or increase with renewable energy market growth. For example, grid congestions and the need for new transmissions lines usually only occur once significant renewable electricity production capacities are installed. Also some infrastructural barriers can occur, such as supply chain bottlenecks, which can be rather local (see Table 10). In addition, high-end barriers can be caused, for example due to competition for sites and resources because the most cost-effective renewable energy potential has already been exploited, or power system limitations like temporary curtailment of certain supply-driven renewable electricity technologies. Moreover, barriers can also be caused by the lack of skilled labour, as presented in Table 9.

Interesting point of view is that the major question facing policy makers in advanced countries is no longer how to remove all the barriers preventing renewable energy growth, but how to manage renewable energy growth under the new system limitations.  
[Klessmann et al, 2011]

Table 9. Barriers caused by lack of skilled labour for renewable energy [Modified from Klessmann et al, 2011]

<b>Lack of skilled labour</b>	<b>Options for policy response:</b>
Lack of skilled labour (e.g. for planning and installation), problems with the guarantee/ warranty/ maintenance regime	Provision of sufficient training and qualification programmes, integration in vocational programmes, guidelines for planners or architects, legal requirements for guarantee/ warranty
Lack or short comings of certification schemes for installers	Appointment of certification bodies, improvement of certification schemes

Table 10. Supply chain bottlenecks for renewable energy Modified from Klessmann et al, 2011]

<b>Supply chain bottlenecks</b>	<b>Options for policy response:</b>
Restricted access to technologies (only a few technology providers, lack of production capacity, lack of R&D capacity), bottlenecks regarding feedstock supply (e.g. steel, silicon, etc.)	Stable and long-term policy framework and targets to build trust in future markets and reduce risks of investments in supply chain

### **Barriers for active demand and smart metering**

Barriers against the development of **active demand** and possible solutions to those were studied in ADDRESS (Active Distribution networks with full integration of Demand and distributed energy RESourceS) project (ADDRESS, 2009). Summary of these barriers and potential solutions to overcome barriers are presented in

Table 11. According to the Six, Fritz and Kessel (2010) those barriers can be clustered into 8 groups:

- 1) the acceptance of active demand by different power market participants,
- 2) regulatory framework issues,
- 3) existing contractual arrangements,
- 4) conflicting interests of different power market participants,
- 5) an appropriate pricing model,
- 6) the monitoring of service provision,
- 7) information management and,
- 8) a number of risks that may worry potential users or suppliers of active demand systems.

### **Intelligent energy measuring barriers**

Main barriers for cost efficient operation of intelligent energy measuring are lack of customer orientation, general operation rules and business concepts; as well as lacks of the openness and generic purpose usage of knowledge exchange interface and delays due to existing systems and organisation models. [Koponen, Pykälä and Sipilä, 2008]

Distribution system manager of electricity and district heat networks is in many countries responsible for taking care of measurement for billing. In practise this means that costs of measuring are in the end paid by the end customer. Nevertheless, in DSO's investments for billing measurement system of energy consumption, they don't typically have any drivers to take into account the needs of end users and his/her energy management and energy efficiency service. As a result, current measurement data for the billing is not very suitable for the end user or energy service provider with reasonable and predictable costs. In addition, energy companies may be reluctant to let others to utilise the measurement investments they have done. [Koponen, Pykälä and Sipilä, 2008]

### **The close relationship of barriers and risks**

Barriers have also a close relation to the risks of the projects. Kleissmann et al (2011) states that reduction or removal of the risks of the project is one significant issue when breaking down the financial barriers. One of the reasons is that reducing risks reduces the costs of capital. This is why feed-in tariffs, (which minimise revenue risks for the renewable energy producer) tend to result in the lowest specific consumer costs (per €/MWh of new renewable energy) of all European support schemes for renewable energy sources; if feed in tariffs are well designed and other, non-economic barriers are manageable. Moreover, also the non-economic barriers can be project risks for the developers and investors of renewable energy projects. Thus, non-economic barriers can increase project development costs or capital costs for the project; but also they can reduce energy sales revenues. Thus, removing of non-economic barriers helps also to reduce financial barriers and the required policy costs of renewable energy promotion. [Kleissmann et al, 2011]

More about risks related to smart energy projects and service businesses are discussed in Chapter 4.

Table 11. Barriers against the development of active demand [ADDRESS, 2009]

<i>Barrier</i>	<i>Affected participants</i>	<i>Potential solutions</i>
Acceptance of AD by electricity producers	Decentralised + centralised electricity prod + electricity prod with regulated tariff	Provision of the right incentives to use AD. Give insight in benefits of use of AD
Acceptance of AD by retailers	Retailers + BRPs	Further investigation of relationship between retailer and aggregator; 2 particular cases to consider in detail: Retailer = aggregator and retailer ≠ aggregator Gain insight in benefits of use of AD Information management
Acceptance of AD by BRPs	Retailers + BRPs	Level of importance depends on level of deployment of AD Gain insight in benefits of use of AD Relationship aggregator – BRP Information management
Impact of AD on the network loading situation	DSOs + TSOs	Level of importance depends on level of deployment of AD (Temporary) restrictions on use of AD Technical validation process Buy back services
Influence of AD services on the efficiency assessment of DSOs and TSOs	DSOs + TSOs	Level of importance depends on level of deployment of AD Design of an appropriate regulatory scheme
Impact of AD on the control area balance	TSOs	Level of importance depends on level of deployment of AD Use of AD linked to trading activities Transparency towards TSO Reasonable estimations of impact of AD
Minimum requirements on the volume of AD services	All participants in AD markets	Definition + standardisation of AD services Design an appropriate regulatory and market scheme Grouping AD services of several aggregators
Lack of allowance to use AD services to compensate generation imbalances	All participants wishing to optimise their electricity procurement by AD services	Allow use of AD flexibilities for imbalances on generation side Regulation
Structure of ancillary services obligation	All players with ancillary services obligations	Design reserve obligation to allow production and demand flexibilities

(continue in next page)

Lack of incentives to manage imbalances	Decentralized electricity prod + electricity prod with regulated tariffs	Design an appropriate regulatory and market scheme
Regulatory treatment of cost associated with AD services for DSOs and TSOs	DSOs + TSOs wishing to use AD services	Design an appropriate scheme with incentives for efficient AD solutions
Contractual issues	All participants involved in AD	Regulatory framework should allow flexibility in setting up or adapting contracts with AD
Inconsistent or redundant AD service requests	All participants involved in AD	Design an appropriate market scheme Cost/benefit sharing Further Investigation TSO-DSO-aggregator relationship
Conflict of interests for DSOs in the context of validation of AD	DSOs who validate the feasibility of AD services (network point of view)	Design an appropriate regulatory scheme
Inappropriate pricing model	All participants involved in AD	Design appropriate pricing model
Monitoring of service provision	All participants involved in AD	Measure total reaction Capacity-oriented vs use-oriented approach Consumer profile or prototypes Actual measurement in Energy Box Forecasted load curve by aggregator or by the buyer Position of the retailer at gate closure Target load curve or target curve for load modification specified by the buyer (or aggregator)
Inappropriate information management	All participants involved in AD	Appropriate information management within regulatory/legislative framework
Uncertain AD availability	All participants wishing to make use of AD services	Deal with it by market schemes (cfr cross-border capacities) + contractual framework Provide alternatives for AD
Uncertainty of real network topology	DSOs and TSOs wishing to use AD services for network relief at specific locations or to provide tertiary reserves at a specific network node	Information exchange aggregator – DSO and/or TSO(different level of detail possible)
Uncertainty of load recovery (energy “payback” effect)	Retailers + demand aggregators + BRP + TSO/DSO + consumers	Take it into account in predictions + in AD services definitions + investigate impact of length of AD cycles on electricity cost
Inappropriate activation dynamics of AD	TSOs wishing to use AD for tertiary control	Level of importance depends on level of deployment of AD Gain insight in predictability (e.g. field tests)

## 2.5. Market needs based on web questionnaire

The web questionnaire was the second approach to study the state-of-the-art of the markets and service and business models in district energy business. The web questionnaire was performed in partner countries during May-June 2012. The main research questions for the questionnaire are presented in Annex D. The questionnaire was translated to 6 languages (NL, IT, BE, PL, ES, FI) in addition to the English version. The delivery of the questionnaire link with forewords was done by the partners in the country and there was no centralised distribution. The questions and results are presented in Annex E.

A total of 933 answers were received for the questionnaire. A majority of the answers were from Italy (684), Belgium (154), Finland (64) and Poland (17). Rest of the answers were received from Germany (8), Spain (3), Netherlands (2) and United Kingdom (1).

## Target groups / stakeholders

Five main stakeholder groups were identified for the questionnaire (Figure 6): **private person or company end user, service provider, land area or real estate developer and public authority or policy maker**. Separate actors within these main groups are presented in Figure 6. Figure 6 also presents the number of answers received for the questionnaire per a certain stakeholder group. The group of

“Others” includes persons such as experts and accredited energy auditors, who did not fit the predefined stakeholder groups.

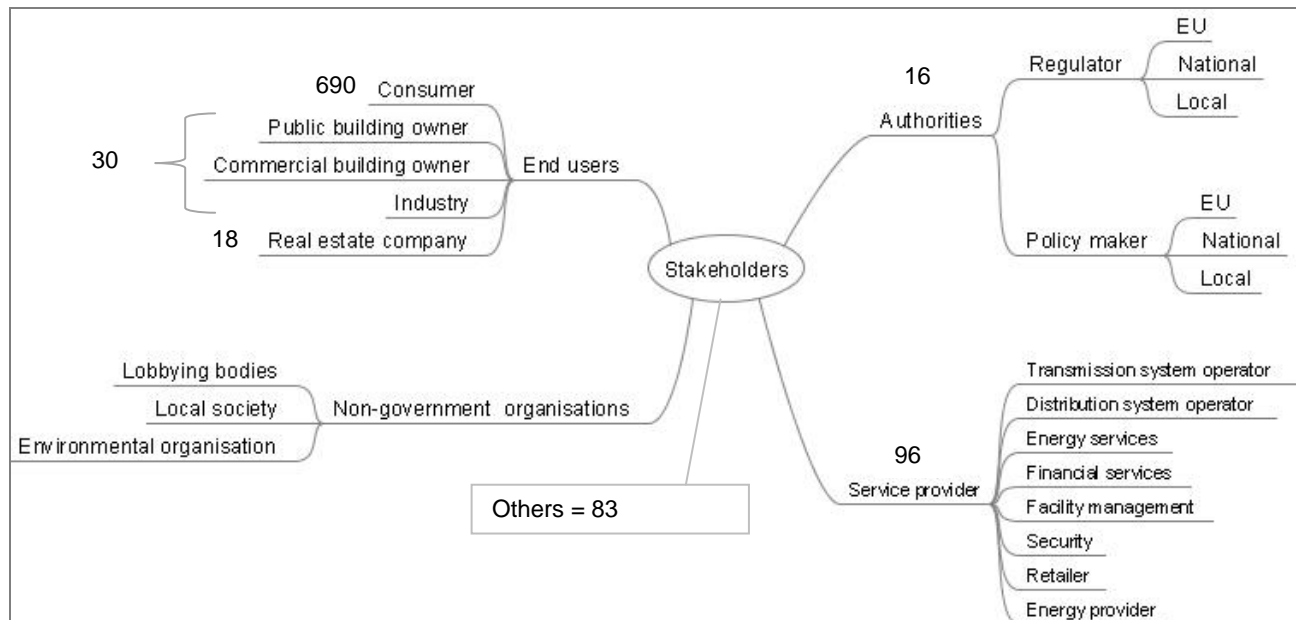


Figure 6. Stakeholder groups

There are some differences in the scattering of the answers among the different stakeholder groups within the three countries from which most of the answers were received (Italy, Belgium and Finland). As presented in Figure 7, the respondents of Italy and Finland represented all of the predefined stakeholder groups. The respondents from Belgium were mostly from the private person end user group. The private person stakeholder group is however dominant in all of the three countries.



Figure 7. The share of the answers per stakeholder groups

## Existing services

The questions regarding existing services were directed for two stakeholder groups, the private person end user and company end user groups. Private person end users identified electricity, gas and water as their main services as presented in Figure 8.

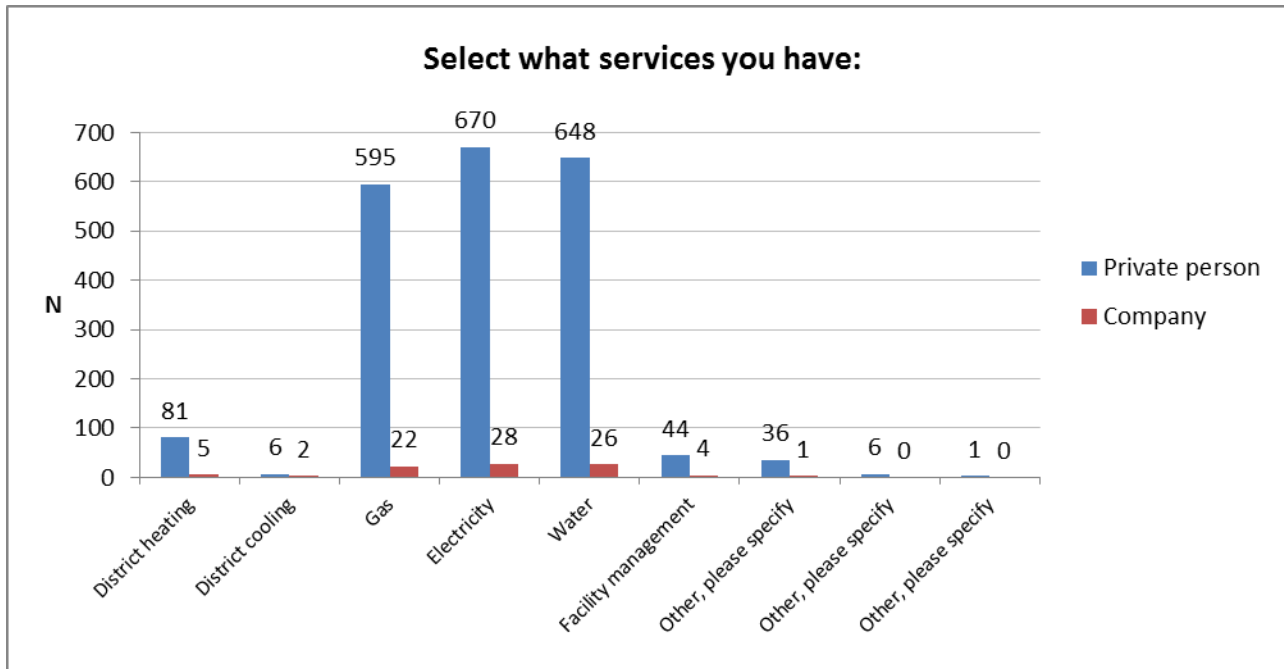


Figure 8. Existing services within the end user groups

## Market needs and offerings of service providers

Out of the 714 answers that was received for the question “How important is it for you that the energy is produced in “green” way (by renewables, environmentally friendly, etc.)?” over 90 % of respondents thought it is very important or important that the energy is produced in a green way. Almost 70 % also thought that the energy should be produced locally. Although over 90 % thinks that cost of energy is important, almost 70 % of the respondents is willing to pay 1 % or more for renewable energy.

Receiving frequent information about energy consumption is the interest of a vast majority of the respondents, however over 80 % thinks it is important to have energy available at all times. Yet, over 80 % of the respondents would be willing to adjust their consumption according to the data provided by a smart meter. The payback period of the smart energy system, in the opinion of over 82 % of the respondents should be less than five years. As presented in Figure 9, over 87 % would likely or extremely likely use a smart energy service to minimize the energy consumption of their house.

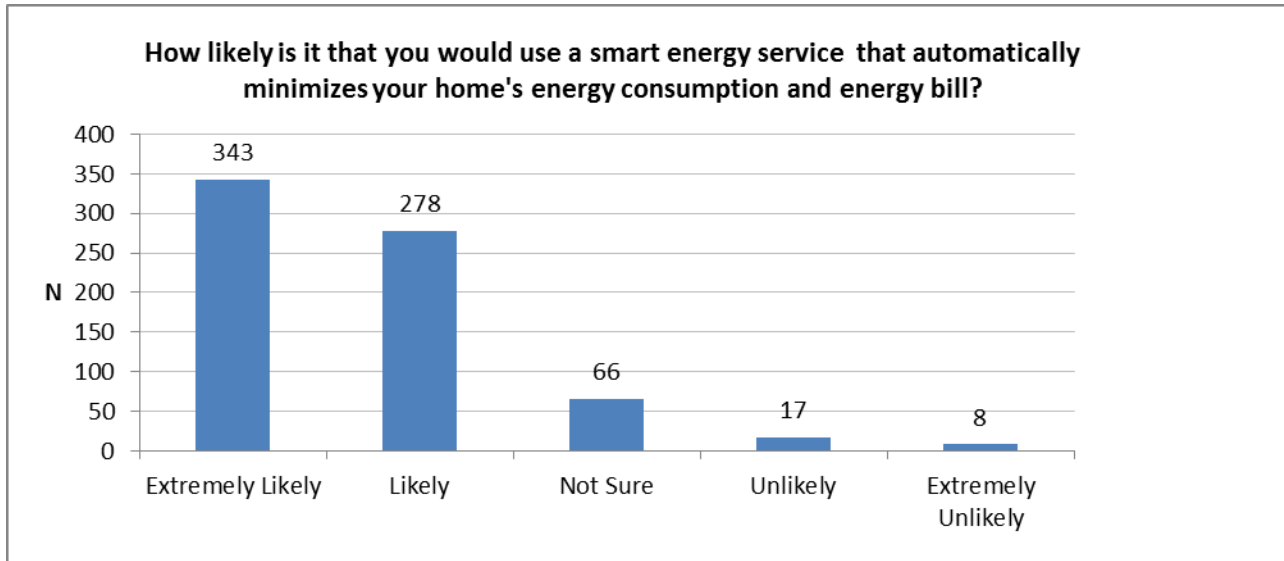


Figure 9. Respondents willingness to let a smart energy service to minimize their energy consumption

A bit over 20 % of the respondents (end users) already produce energy by renewables and over 80 % would be ready to do so in the future in order to reduce their energy bills. Out of the 638 respondents over 65 % would be interested to join buying pools and over 30 % both demand side management pools and to have active role in energy production, i.e. to join producers' pools as presented in Figure 10.

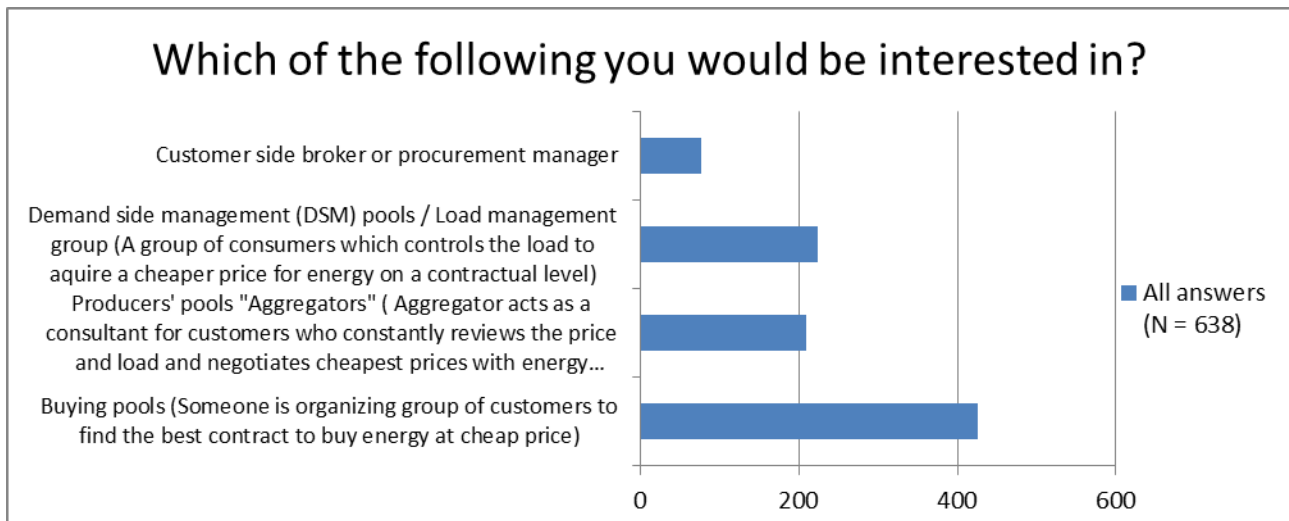


Figure 10. End users willingness to participate in new ways

74 % of respondents would be interested to buy bundled energy services (combining for example gas, electricity, heat and cool) and 47 % would be willing to buy energy usage information that opens new business opportunities to current and new operators..

## Barriers and incentives

There is not a clear opinion within the stakeholder groups (other than the end user groups) on who should make the initial investment on the smart energy systems. Energy suppliers and distribution system operators are seen as the most convenient investor, but public sector is also thought to be one of the key instances for making the initial investment. Some of the respondents also say that it should be the end user who is responsible for the investment.



The biggest barrier regarding the implementation of smart energy districts on Europe identified by the respondents are the reluctance of the present actors within the energy business to change their present business models. Lack of experience and knowledge is also seen as a barrier by almost 50 % of the respondents as is the lack of political awareness. Also, the lack of affordable capital and the payback period of the new systems are considered to be rather large barriers as presented in Figure 11.

Key solutions to the barriers presented in Figure 11, according to the respondents, would be:

- Regulation that would encourage to make the investments,
- development of new financial models,
- promotion of research programs and demonstrations and
- customer-driven new business models and service offering

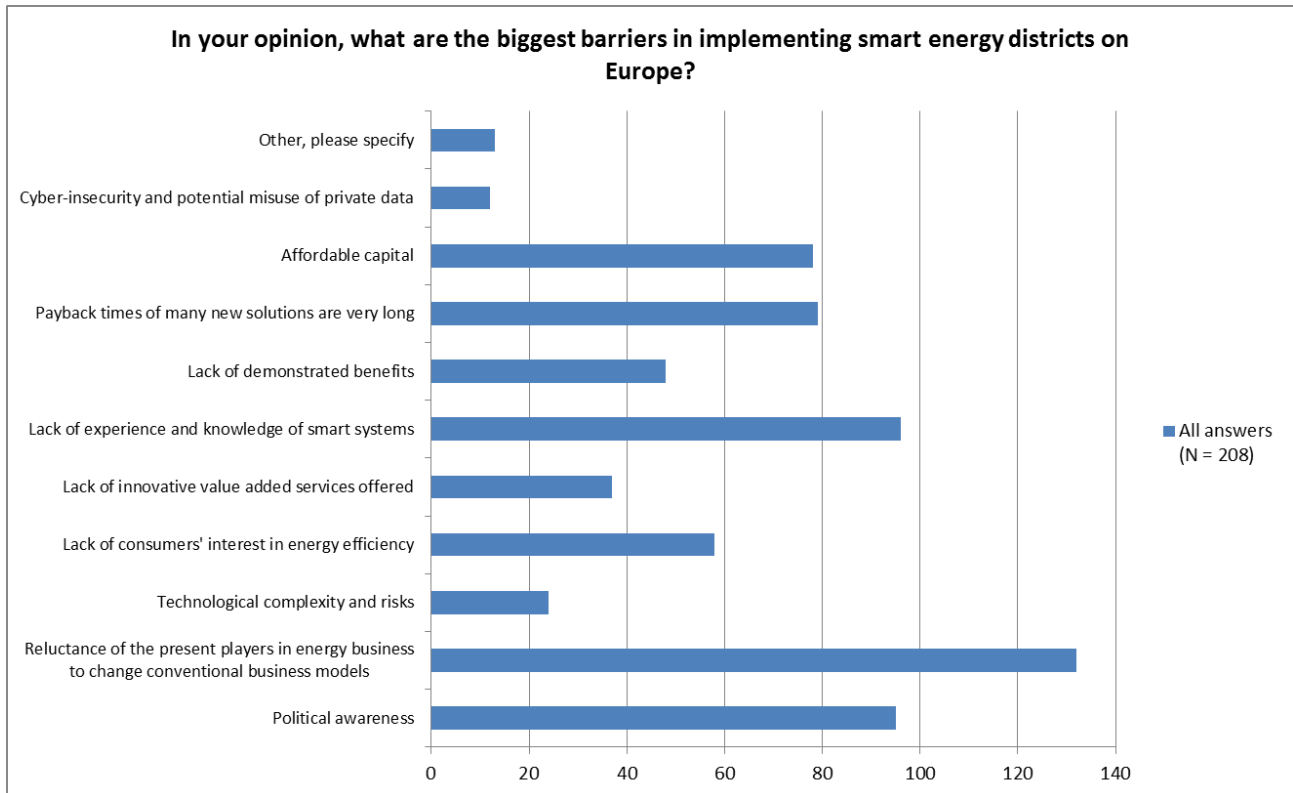


Figure 11. The barriers of implementing smart energy districts on Europe

## Future visions of services & business

The most potential new service created through smart energy solutions is, according to the respondents, bundled energy services. Also services regarding the control of energy consumption and energy costs are seen as a potential new service, besides energy efficiency services (ESCO). The respondents opinion on new services is presented in Figure 12.

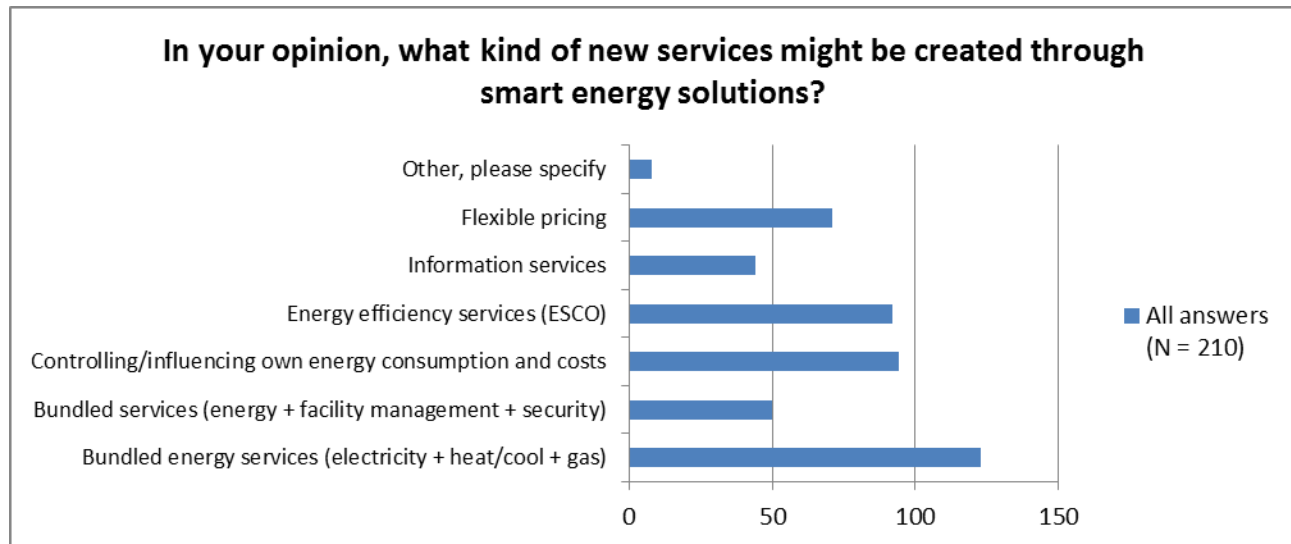


Figure 12. New service potential from smart energy solutions

The non-end user stakeholder groups were also asked what kind of services they would like to sell, the answers are presented in Figure 13. The most intriguing alternative was energy efficiency services (ESCO), but bundled energy services and services regarding energy consumption controlling were seen as interesting services to be sold by the stakeholders. The answers are in line with the respondents view on potential new services that could be created through smart energy solutions even if only roughly one third of the respondents are willing to sell new services.

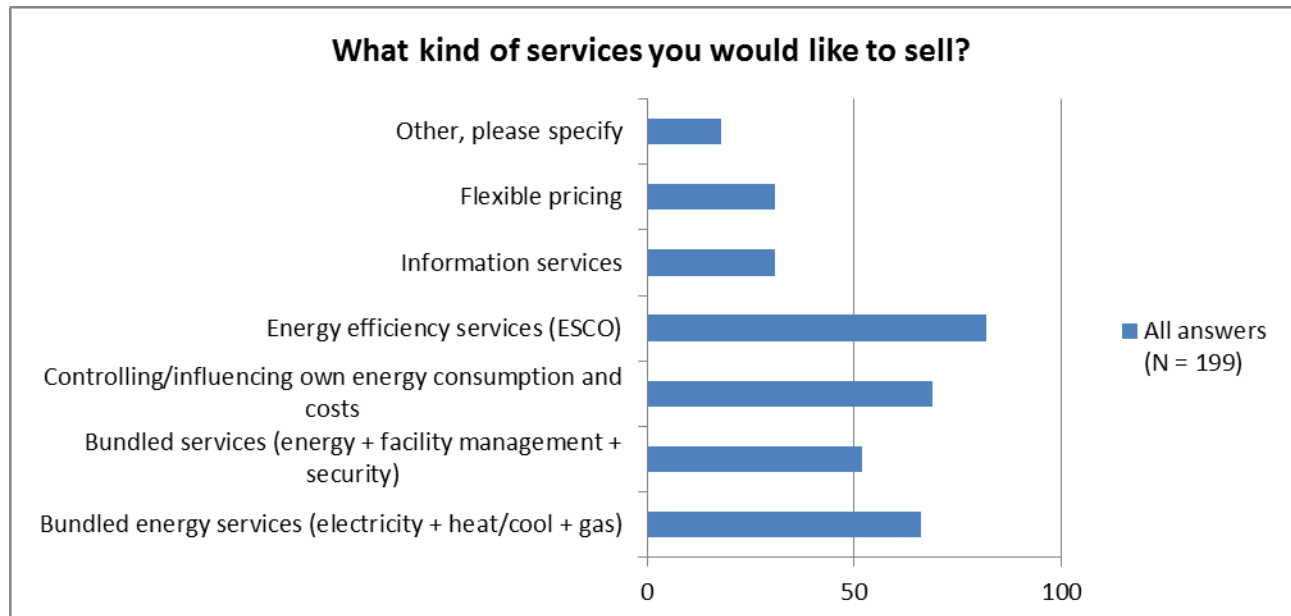


Figure 13. The services, which the respondents would be willing to sell.

### 3. Ideas and new emerging business and service models for e-Hub systems

Proposals for different type of business and service models to be implemented in e-Hub case areas are given in this chapter. This includes, among others, the description of the alternative new energy service concepts and content, including analysis of the business models, energy service concepts and content and earning logics in business networks. In addition, the relations, dynamics and influence of the different stakeholders on each others, as well as different ways and possibilities for co-operation will be analysed. The work will be continued with detailed case study analysis of the concepts in task 6.4.

The common approach in analysing business and service concepts was selected and described. The approach of Osterwalder 9 step analysis of business is presented in Table 12. This study used the similar approach modified for project purposes.

Next, case analysis for different concepts is presented, consisting of several case systems and areas, as well as several concepts for energy services. This is based on interviews and workshops with stakeholders, such as energy companies, facility and real estate companies, ICT sector and end users. The goal was to describe value chains and earning logics of selected cases; including analysis of stakeholders in specific case concepts and their influence (e.g. money flows) between stakeholders.

Other discussion topics were: market needs for financial models arranging energy services, existing motivation for different financing models, needs for new instruments (especially for district developers), possibilities for different financing models, and earning logics and motivation for offering different financing models.

Table 12. One possible approach for analysis of business models (Osterwalder et al, 2005).

Pillar	Business Model Building Block	Description
Product	Value Proposition	Gives an overall view of a company's bundle of products and services.
Customer Interface	Target Customer	Describes the segments of customers a company wants to offer value to.
	Distribution Channel	Describes the various means of the company to get in touch with its customers.
	Relationship	Explains the kind of links a company establishes between itself and its different customer segments.
Infrastructure Management	Value Configuration	Describes the arrangement of activities and resources.
	Core Competency	Outlines the competencies necessary to execute the company's business model.
	Partner Network	Portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value.
Financial Aspects	Cost Structure	Sums up the monetary consequences of the means employed in the business model.
	Revenue Model	Describes the way a company makes money through a variety of revenue flows.

#### 3.1. Analysis method for alternative new energy service concepts and content

The analysis of the existing and alternative new energy service concepts and content of some of the identified E-HUB cases was performed by workshops and interviews. The goal of the workshops and interviews was to describe the current and possible new services and business models in district energy. The other goal was the identification of new opportunities to extend the current models with new idea. The

common research questions were set as basis for the workshops and interviews. The common fact sheet was developed for helping the description of the cases.

## Research questions and common fact sheet

The following aspects describing the service and business models were included in the workshops and interviews:

- Service scope
- Service contracting
- Stakeholders involved; Roles and responsibilities
- Value chain & interactions between stakeholders
- Description of the business model, using e.g. Osterwalder's model
- Customer (end-user) interaction
- Business (ICT) solutions
- Risks, barriers, drivers, incentives
- Legal aspects
- Financing aspects
- Cost-benefit aspects

The common research questions and background material for the workshops and interviews is presented in Annex F. The fact sheet is presented in Annex B.

### 3.2. Workshops and interviews

The workshops and interviews were performed in 4 groups consisting of local partners. *Belgium* workshop focused on smart thermal networks and smart electricity grids. *Italian* study was done by interviews focused on 6 case studies. *Finnish* study was done by one workshop with district heating companies and several interviews. Part of these interviews are reported in (Kohonen et al., 2011). *Netherlands* study was done by 3 interviews focused on case projects and 3 workshops with stakeholders in district projects.

The above mentioned workshops and interviews were reported by the national teams and the common format for the reporting was not used. The following sections are presenting the main results of the workshops and interviews.

## Workshop/interview results Belgium

In Belgium VITO organized a workshop on July 2012 with representatives from two distribution system operators, a retailer who is also a balancing responsible party and producer and three different research institutes. The workshop focused on the non-technical issues of smart energy concepts at district level and was divided into two sequential sessions: smart thermal networks and smart electricity grids.

### **Smart thermal networks**

In Belgium district heating is still rather uncommon, but currently some parties are uniting themselves in “Warmtenetwerk Vlaanderen” (heat network Flanders). This association wants to come up with innovative solutions and stimulate exchange of knowledge in the framework of heat networks. The first part of the workshop was therefore aimed at current issues and trends for district heating in Belgium.

### **Future for district heating**

In general, the application of district heating in Belgium is currently not economically feasible. According to the participants, the feasibility of a district heating project depends on the level of isolation (heat demand) of the buildings, the availability of residual heat, the regulation and the spatial ordering.

- In Belgium houses are typically widespread, except in city centres, which isn't ideal for the application of district heating. The application of a central heating system for apartment buildings or blocks of houses can already be profitable at the moment.
- Energy performance regulations for buildings are getting more stringent. At the moment these are mainly determined at housing level (heat pumps, isolation). The future of district heating will depend on whether a connection to a heating network will be taken into account in these calculations.
- There is a new regulation that allows distribution system operators not to invest in gas networks when there is already a heat network or when current heat networks can be expanded for new districts. This trend contributes to the further development of district heating in Belgium.
- The future of district heating in Belgium will to a large extent depend on the subsidy system. Currently the Flemish government is working on a support scheme for large investments in “green heat” and projects that valorise residual heat. The selected projects get a fixed amount depending on the amount of produced heat (maximal support will be 6 €/MWh of heat produced). This subsidy system should be expanded to make investments in district heating more profitable.

### **Financing district heating projects**

At the moment there is no consensus on who needs to invest in district heating projects. Since district heating is a local theme, it seems logical to have at least some involvement of the local government / municipality, although there are also some private partners showing interest in the Belgian district heating market. When only private companies are allowed to invest, there might be a risk that only the very profitable projects will be developed. Projects with a longer payback time or where synergy is possible will not be developed since the market would be too fragmented. A model of mixed ownership and management (public and private) seems to be the most probable model. In districts that are off the gas grid, the ownership and management of district heating will probably be done by the DSO.

### **Pricing model**

Different cost models are currently being looked at in Belgium. There is no consensus at the moment, but both the “niet meer dan anders (NMDA)” (not-more-than-otherwise) principle and the cost plus principle are being discussed. In the first case the consumer doesn't pay more for its heat consumption than what he would pay if he would use natural gas for individual central heating; In the latter case the heat price is calculated according to its cost and a markup is added. Since prices should be reasonable it seems appropriate to determine competitive prices according to the NMDA principle, certainly when consumers would be obliged to connect to the heating network.

### **Responsibilities and roles**

There is general consensus that the different roles (production, distribution and supply) should preferably be done by one actor since heating networks are natural monopolies. Since heat networks require large investments splitting up the different roles will lower the margins of the individual actors. One could imagine that different producers connect to the same network. However in this case it would be difficult to determine who can supply heat when demand is low. Furthermore bigger production installations are more profitable than different small ones.

### **Smart Electricity grids**

This part of the workshop focuses on demand response and distributed generation. The first pilots with smart meters are ongoing. Furthermore some projects are preparing field trials for residential demand response.

#### **Demand response**

A distinction can be made between price-based (dynamic tariffs) and incentive based demand response (direct load control). The responsiveness of consumers to dynamic tariffs is questioned. Probably direct load control will have better results. The participants agreed that both options can coexist. Dynamic tariffs can be used for longer term to short term adjustments (e.g. week ahead – day-ahead), while direct load control can be used for real-time adjustments.

#### **Distributed generation**

Distributed generation at district level is gaining importance although most distributed generation is currently being installed at building level. A major factor is again the spatial ordering. In highly concentrated regions distributed generation at district level might be profitable, while in dispersed regions individual installations are preferred.

#### **Risks and barriers**

- Since the liberalization of the electricity markets, consumers are free to choose their own retailer, while energy concepts at district level can sometimes be initiated from a specific retailer. One potential barrier is how to convince consumers to opt for this specific retailer.
- A potential risk for district heating is the lack of competition when you have a contract with one monopolist. Appropriate regulation will in this case be needed.
- District heating projects are characterized by large investments and long payback times, which is mentioned as the main barrier for district heating in Belgium.
- At the moment it's not clear yet whether Belgium will opt for a full roll-out for smart meters. This is an important barrier for smart electricity grids.
- The tariff periods are fixed at the moment. An adaptation of the existing regulation would be needed to allow retailers to offer dynamic tariffs.

## **Workshop/interview results Finland**

The Finnish study was done by one workshop with district heating companies and several interviews. Part of these interviews are reported earlier in (Kohonen et al, 2011). The workshop with district heating industry was initialised with the state-of-the-art literature review of services and pricing methods in district heating sector. Additional information can be found in the Annex I of this report.

### **Summary of services and pricing methods in district heating in Finland**

The strengths of district heating, such as easiness and reliability, can still be used as marketing arguments in the future when trying to attract new customers, many of which are owners of low-energy buildings. In addition to this, new innovative service and pricing models focusing on real customer needs are necessary for maintaining the current market situation. Also, new technologies, such as remote metering, hybrid heating systems will become more common and they will provide new challenges but also opportunities for district heating.

High connection fee has been identified as an important barrier for the customers to choose district heating, and new pricing models could be used to reduce this problem (for example lengthening the payment time or providing an option of renting the heat distribution centre). Also, in the future the favour of sustainable lifestyles and “green heat” is expected to increase and it is necessary for district heating companies to develop their products in order to respond to the customer demand.

As in other technical fields, a transition towards a service-oriented way of thinking is taking place also in district heating companies. Providing comprehensive service packages (such as a “keys in the hand”-

service, or a connection fee including the heat distribution centre and its maintenance) and focusing on different needs of different customers could be methods for district heating companies to increase the attractiveness of their products. Different consultation services will also be demanded in the future as customers often feel that information is not easily available, and also, as customers want to have a stronger control over their energy consumption habits.

Figure 19 summarises the main future trends and problems and proposes also solutions how district heating can maintain its market position in the future.

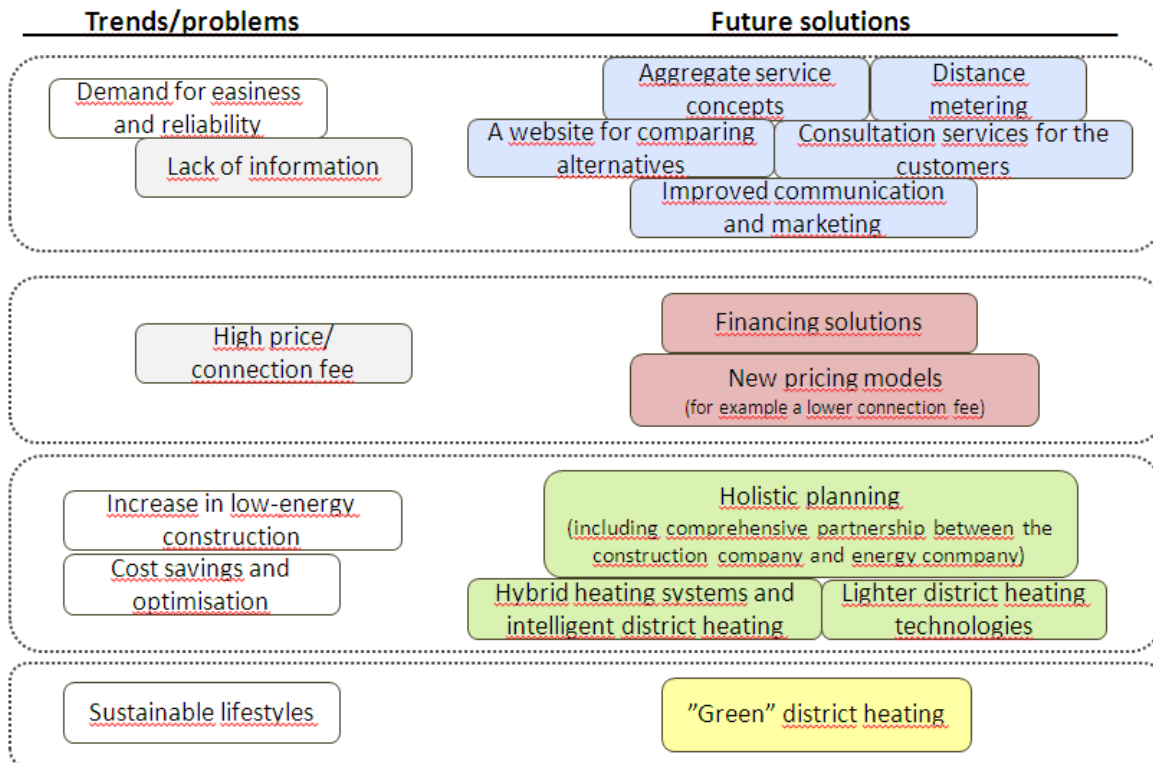


Figure 14: Main future trends, problems and solutions for district heating.

### **Interview FIN1 – case Company One1 delivering renewable energy solutions for districts**

Finnish company One1 supplies district renewable energy solutions as a turnkey project. It focuses on developing and supplying energy concepts from the initial concept analysis to the end of the project's life cycle. One1's sales and development director, Interviewee, was interviewed in May 2012.

**One1 concentrates on B-to-B, customers**, typically energy companies, municipalities and cities as well as large construction companies. According to Interviewee, energy companies have often natural role to be an energy producer also in smaller areas, which are farther off from current energy networks. One1 aims to act as a cooperation partner of energy companies, and not as their competitor.

Main focus of One1 is to help their customers to solve their problems by providing knowledge, and supplying necessary solutions and management of projects. One1 provides both (heat) energy, but also other services in co-operation with its partners. One1 can take care of system integration, e.g. definition of systems, how energy consumption data should be sent and utilised. Integration is needed for IT and controlling systems, but also in also invoicing and reporting etc. In addition, planning of operation roles of each stakeholder is important, and the structure varies a lot in different cases, depending on the involved stakeholders and combinations, or e.g. whether the (heat) entrepreneurship is involved. Hence, flexibility is the key issue in all operation of One1.

One1 provides also **energyportal service**, which gives areal energy consumption information (which can be seen freely by everyone) and r can sign in to see their own specific energy consumption data).

Energyportal gives information about:

- energy reports & information to customers (incl. heat & electricity) - energy data is got from energy companies
- used energy sources to produce energy
- weather information
- advises on energy savings and renewable energy
- other services can be ordered: cooperation partners will execute, e.g. building maintenance

Interviewee states that independent from the specific case, there is certain uniformity and same kind of challenges in every local renewable energy project. First of all, renewable energy is a broad term; lots of different technologies and knowledge is needed. Also the operation field is diverged: with different geographical locations, environment, countries, new or old district etc. Many renewable energy systems are also relatively new, only a few pilots of hybrid renewable energy systems exists, and thus courage is needed from the actors. In Finland, only pellet & bio mass boilers are quite ready in a neighbourhood level systems, other systems are newer. Other challenges are typically: lack of resources and/or knowledge with the staff (of energy companies and municipalities); lack of financial resources; municipalities and energy companies may not want to be developers by themselves; and projects have long time scales and typically projects start slowly.

Interviewee told that **largest problem is typically financing**: Who will invest? Who does it naturally belong to? This is why new combinations and arrangements for financing are needed. Often it is difficult to calculate exact values and benefits from the finance point of view. Also courage is required in implementing new solutions.

According to Interviewee, energy itself does not raise interest, you have to include also **other services** as well to the offer. Also activation and integration of community is included. Residents are interested about what is going on in the residential area, and One1 operates together with energy companies & provides, enabling thus a broader contact area to residents.

Interviewee mentioned also, that there are different kinds of problems in areal development and implementation projects. In addition to problems of execution phase, there are also problems related to services, program development and development of operation. Moreover, broad knowledge is needed about hybrid renewable energy systems and their implementation; and broad networks of stakeholders are involved.

Interviewee states that energy architecture should be better taken into account (including also ICT systems) already in the beginning of the project and designing of city plans, which is also valid for involving end users and residents, which affect e.g. to the need of transport and services.

Interviewee has notified that currently the support politics is a bit illogical, and often municipalities do not have resources to implement the plans. He suggests that financial support should be directed more to energy companies, which are owned by municipalities. Clear addition to financial support is needed to do investments in local, areal renewable energy systems. Moreover, energy company could be the one choosing, which area will be developed, and take care of the designing of city plans, instead of a municipality doing it. However, municipality needs to be active; they could guide energy companies to do city planning, while the energy company could get sufficient financial support for the area.

### **Interview FIN2 – expert interviews**

Several interviews we performed at the early phase of the project and these were reported in (Kohonen et al, 2011). The smart energy solutions proposed by the experts is summarised in the following (note: references can be found in original document D6.6, Kohonen et al, 2011):

According to Hänninen (2011), before discussing what new services smart solutions can provide we should discuss who should develop and provide those services. As there is a division between monopoly and market activities in electricity markets, the question is with whom the end customers interact when it comes to new services. Hänninen argues that there should be a clearly defined role for monopoly actors,



which in general are operating the grid so that security of supply is guaranteed and that a market place is created for suppliers and end customers. Thus the suppliers should be the ones to develop and provide new services. It is also possible that third parties become active in providing new services. For example ThereCorporation (2011) develops products and services in household automation. Unfortunately in Finland there has not been much of this kind of service development, as the price seems to be the only thing that matters for the end customers. (Hänninen, 2001)

Hänninen (2011) notes that there is currently discussion in the Nordic countries whether there should be only one interface to customers in the electricity markets. This means that the current situation, in which customers get different bills from a distribution company and an electricity supplier would be replaced by only one bill from the supplier. The supplier would then pay for distribution to the distributor, so the customer could only work with one energy company. England has this kind of model already. Hänninen thinks that one interface model could also improve market development to more service-driven competition instead of just price competition. Different suppliers would start offering new services.

Auvinen (2011) continues that their key finding is that there is demand for turnkey solutions and some kind of service integrator. End customers can't sort out all different technology providers, processes, licenses and subsidies. Thus there should be only one interface or service provider for end customer that deals with all that, and coordinates the processes with subcontractors and partners. Otherwise it is too complicated for the end customers. She notes that new service design is needed to get consumers involved and willing to pay for new technologies. Oostra (2011) also notes that facilitators might emerge to help existing businesses with their smart solution transition, by providing information about business opportunities and enhancing collaboration between different industry actors.

Suppliers must also think whether they want to participate in developing new services at all. They might fear that new services could indirectly reduce their profits by enabling customers to reduce their consumption. Koivuranta (2011) argues that there are two reasons why suppliers have to adapt to smart grids even if all of them would not want to. Firstly, at least Finnish law demands retailers to inform customers about their energy consumption. Thus regulation sets the boundary that the companies must obey. Secondly, markets will determine if there are profitable opportunities in energy efficiency. If there will be opportunities to reduce end customer energy consumption in a profitable way, there will be some other company delivering that service if retailers won't start providing it. Koivuranta notes that current retailer companies might disappear from markets altogether if they can't adapt to the new situation.

The interviewees mention a lot of different services, but most of them are mentioned in the literature as well. Hyvärinen (2011) notes that all kinds of software applications are needed to control power flows, energy storage and loads and to provide price signals and information on energy use to the different parties. Most mentioned services are targeted at customers, but especially Six (2011) discusses services for suppliers and distributors. New information could be used for supplier risk management and portfolio management so that suppliers can do their business in a more efficient way so that they might become more competitive and offer lower prices to their consumers compared to a market player who does not benefit from intelligent options. Grid-related services include voltage control, transformation load reduction, balancing services and others to manage grids in a more cost-efficient way. Six continues that there is a challenge in bringing them all together but they are important at the same time. He argues that demand side management and other grid control should take into account both the commercial objectives of reducing market price peaks and the boundaries of the grid so that load peaks would also be reduced. Also Knigge and Mulder-Pol (2011) note that DSOs and suppliers might have contradicting goals and even different actors' internal goals might be contradictory. For example Enexis has three goals. Firstly, they want to optimize grid capacity, secondly, they want local demand to be met by local sustainable production, and the third goal is to increase market participation.

Most new services are targeted at end customers. Customers can be informed of their consumption for example by displays showing real-time consumption possibly distinguishing between different home appliances. Maintenance of appliances could be done from a distance (Bongaerts, 2011). Monitoring could be possible also with mobile devices. Vattenfall already has a service that customers get a text message, if there is a blackout in their household. This is a suitable service for example for Finnish summer cottages, since many of them are located in areas that have electric lines above ground and are vulnerable to thunderstorms and falling trees. Fortum has a pilot project called Hand Held (Koivuranta,

2011). In that project around 200 test users have been given a mobile device that they can use to monitor their home energy usage. The aim is that in the future people could both monitor and control their home appliances by a real-time mobile system. There are also pilot projects where the customer interface includes information about consumption, energy prices and the type of production. Some equipment might be able to use different types of energy, for instance gas or electricity. With a smart system these devices can decide automatically which source of energy to use depending on price or convenience (Gordijn, 2011a). When customers have their own DG, the system could optimize almost real-time when it is best to use electricity from the grid and when to use own production. Hänninen (2011) argues that this development reduces the customers' dependence on the national grid and eventually we will get rid of all outages. In general, the opportunities of current IT systems will be available in energy consumption as well.

Another example of new services is demand response. If the end customer electricity price would start following market prices there could be possibilities for reduced demand when feasible. For example the supplier could agree with the end customers that their consumption will be cut automatically, if the market price goes over a certain limit. This could be combined with outside temperature metering at consumer's premises, since of course heating can't be turned off when it is cold outside, even if there is a peak. Automation is needed, so customers don't have to pay attention to their consumption on an hourly basis, but rather agree to certain conditions and let the system optimize energy usage within the customer's preferences and without comfort loss.

Furthermore, increased information will provide possibilities for data mining. This would enable better understanding of consumption behavior and thus improved possibilities to understand customer needs. When needs are understood there is a better chance to create additional services that customers are willing to pay for. For example different customers might want to use energy at different times and certain bundles of services could be targeted at certain segments of customers. All depends on when and how the customer uses energy.

In addition smart solutions could provide charging for electric cars and possibly using them as a grid balancing method when necessary. Fortum has a project called Charge and Drive, in which they have established load points for electric cars (Koivuranta, 2011). Customers can use the electric charging point via text message. The text message identifies the customer and thus adds the electricity bill to their phone bill. The project is done together with Nokia Siemens Networks.

Hänninen (2011) argues that in general, energy sectors lack innovation capability, as it is a quite conservative field. Developers should be more innovative, create new needs and verify if different services would work. He continues that for example the text message was invented by accident and it was offered to customers just to try if it might work. And as we know, it was a huge success. Thus, energy sector needs courage to try new thing and be more innovative.

Auvinen (2011) notes that the energy sector needs innovation both in service and in product design. The problem in the new energy business is that in general there is not a huge demand for energy efficiency or saving. Energy efficiency is not an interesting or tangible issue, so it is difficult to commercialize products that people would be willing to pay for. She argues that people don't want a smart meter in itself but it has to be sold to them in some other way that really adds value to them. Even the possibility to save money doesn't seem to help in many cases, new services have to relate to other needs, such as control, security or social needs. More people from creative fields are needed to design new services and help in usability and selling. For example the British company GEO has developed smart meters with similar panels to car speed meters. This appeals to people's need to control the household economy rather than just saving money, since the panel shows how well the customers are in line with the energy and carbon budget they have set themselves. Auvinen argues that the concept has worked because it is simple and understandable. GEO works together with British Gas, because a small company couldn't produce the meters themselves in a profitable way.

Auvinen (2011) continues about another model that has worked in Japan, where smart meters are sold as complementary products with household security systems. Here again energy is not the main issue. According to Auvinen, service designers and psychologists emphasize, that product and service concepts should be simple, usable and appeal to people. Social sharing and visualization usually helps. There are

models in which end customers see their consumption compared to a similar household's average and people can get small rewards if their energy consumption is less than average and they belong to group of top 10 % having lowest energy consumption (or highest energy efficiency). This has led to an overall reduction in energy consumption. A service that seems to have demand in Finland according to market research is a platform where people could compare energy efficiency and renewable energy production options for their household. Currently people don't know of the choices they have and it is very difficult to compare for example whether one should buy LED lamps or invest in something else. The platform should not only compare the costs of different options, but also the effort and user experience.

In conclusion, it is an open question who should develop new services in the first place, but some interviewees argue that it should be the role of suppliers and third parties. Services will be created to both industry actors and end customers. Thus some services benefit suppliers and DSOs directly while others are beneficial if the customers are willing to pay for them. Industry services may include e.g. risk and portfolio management, voltage control and balancing services. End customer services include demand response with automation, remote monitoring and control, bundle of services such as broadband connection in addition to electricity and taking care of the whole energy system rather than just electricity or heat. It is emphasized that energy is a difficult thing to sell and thus a new marketing approach and service design is needed. Energy could be associated with control, security and social sharing. In Finland there is demand for a platform where customers could compare the energy services available to them.

## Workshop/interview results Italy

In Italy bilateral interviews were conducted in order to analyze the distinctive features of six different existing energy districts:

- Innovative energy/heating district based on geothermal source (Polo Energie Rinnovabili Ferrara)
- Traditional district heating model based on CHP (Province of Turin)
- Energy efficient district financed by the European Commission (Comune di Alessandria)
- Eco-district for social housing (Quartiere San Polino, Brescia)
- Production of energy for public buildings based on forest biomass supply chain (Borbera valley)
- Private energy districts of Milan airports

Here below the main results of the interviews are briefly summarized.

### Traditional and innovative urban district energy/heating systems: Turin and Ferrara

With regard to **the cases of Ferrara and Turin**, which adopted respectively an innovative energy/heating district based on geothermal source and a traditional district heating model based on CHP, the same categories of **stakeholders** were involved, with similar **roles**:

- Local Authorities (City, Province, Region): they were involved in the strategic planning and launch of the projects, as well as in granting the legal authorization needed for the construction of the energy production and distribution plants. They also owned the plants in their starting phase.
- Public Utility companies: they were responsible for designing and building the district heating systems, for the commercialization of gas, energy and heating for industrial and domestic use and for the maintenance (O&M) of the district heating networks. They are also owners of the DH plants and distribution networks.
- Research center/University: they were involved as a technical partner in the design and feasibility study phase.

In both cases the **services provided** by the Public Utility companies include:

- Electrical energy segment: electricity generation, transmission, distribution and sales.
- Heating, gas and district heating segment: gas distribution, heat production and sales, district heating services.
- Environmental services segment: urban waste disposal, water management
- Services segment: municipal electrical and heating system management (in addition, in Turin the Public Utility company also provides street lighting maintenance + traffic light system management).

As to the adopted **business model**, it is interesting to note that in Ferrara a service contract between the Municipality and the Public Utility company is in force and establishes the conditions of service.

According to this contract, the heating service is considered of general interest (then some minimum quality requirements must be guaranteed), but is provided at market conditions. Heating tariffs are set according to the market logic, in order to be competitive with traditional heating providers. They also take into account additional services such as the maintenance of pipes and heat exchangers, the amortization of the heat exchangers provided to the Client and the heat meter's lease.

Concerning the other regulated services (e.g. the integrated water cycle, urban waste, and gas and electricity distribution) tariffs are regulated by controlling authorities (AEEG – Italian Authority for Electricity and Natural Gas and ATO – Water and Waste Regulatory Authorities), whilst for free market services (e.g. waste disposal and gas and electricity sales) tariffs are influenced by competition among companies.

As to the regulation of the district heating services, it is important to note that in Italy an ad hoc Authority has not yet been created.

Concerning the **financial sources**, in both cases a mix of national public grants and Public Utility's own funds was used to develop the DH projects. In Turin a European Investment Bank (EIB) loan was also obtained. In both cases, EIB financing and European Commission grants for research and demonstration, coupled with private funds, are considered the best financing mix to support the further expansion of the existing projects.

Both Ferrara and Turin consider as **key drivers for the future** smart grids and ICT platforms like the ones developed within E-HUB, which will allow a more active involvement of end-users and self programming energy consumption. Turin also underlines the importance of developing the district cooling, which would allow to use heat also during the summer (via absorption chillers technology) via 'Smart Thermal Grids'.

Among the **main barriers** identified by Ferrara to further develop its energy/heating services there are:

- lack of a national or regional regulation governing local district heating networks and setting a common framework for minimum service conditions;
- lack of legislation allowing to transfer excess heat to the heating network;
- lack of end users' cultural sensitivity and awareness towards renewable energies.

### **Eco-districts in Italy: the cases of Alessandria and Sanpolino (Brescia)**

We chose to analyze **two cases of eco-districts** that were conceived and developed in two medium-sized northern Italian cities, Alessandria and Brescia. The two eco-districts have quite different distinctive features.

The eco-district in Alessandria can be considered as a urban pilot project at the neighbourhood level, including:

- eco-refurbishment of existing social housing dwellings
- diffuse energy retrofit for the buildings of the district: plan to develop energy audits for 3000 dwellings and to supply resources for energy/building retrofit of 600 dwellings of the district
- new eco-village + elderly house + health centre (sport, swimming, gym)

Among the **main technological features** applied in the eco-refurbishment there are: wood fiber insulation, thermal break windows with triple glazing, passive solar greenhouses, thermostatic valves, mechanical ventilation, connection to the district heating network based on central biomass tri-generation, photovoltaic systems positioned on the roofs or any kind of sheds; high efficiency artificial lighting.

Regarding the **stakeholders and their role**, in the construction phase the following entities were involved:

- The Municipality
- The Local Agency for social housing
- An Engineering and Design company
- Several private construction companies
- An ESCO (responsible to perform energy audits)

In the operation phase, the main stakeholders will be:

- The Municipality
- The Local Agency for social housing
- An ESCO
- The owners of apartments

Regarding the **business model** that will be adopted once the district will be completed and operative:

- The Municipality of Alessandria, which owns the district heating infrastructure, defines the “rules” governing the relationship between the ESCO (energy producer) and the owners of apartments, establishing the maximum tariff for thermal energy.
- The ESCO, which owns the power and heat generation system, will supply the private owners of dwellings with thermal heat.
- End-users while buying the dwelling are bounded to buy thermal energy from the ESCO appointed by the Municipality, having in charge the fuel management, the operative and maintenance costs of the thermal grid and the heat generation units.

As to the **financial aspects**, Alessandria started the first phase of the project thanks to a European Union grant (under the 6th Framework Programme for Research and Development). Additional public resources were made available at regional and national level. For the construction of the nursery, spa and public pool Project Financing scheme was applied.

The eco-district of Sanpolino shows quite different characteristics. It was promoted by the Municipality of Brescia, which issued a public call for bids in 2004 for the its construction, defining the requirements in terms of services, technical systems and energy performance of buildings (a 20% reduction with respect to existing requirements was demanded).

The district consists of different sections, including:

- 1 multi-family building block with 191 dwellings, 1 gym, 1 auditorium and 4.500 m2 of commercial areas;
- 3 multifamily residential buildings with 82 dwellings, 2 day-care centres and 480 m2 of commercial areas;
- 96 single family detached houses.

As regards the **technical features**, the district is connected to Brescia urban district-heating grid. There is a substation which controls the outgoing temperature to the radiators heating systems and heat exchangers for the generation of sanitary hot water. All heating radiators have built-in thermostatically controlled valves and energy (heat) metering / billing is done for each dwelling. All dwellings have controlled mechanical ventilation with cross flow exchangers for heat recovery. Buildings are not connected to the gas grid (each dwelling has induction cooking systems). Buildings have been designed so as to make wide use of renewable energy sources. All single-family detached and semi-detached houses have thermal solar collectors for production of sanitary hot water and photovoltaic panels, with net metering agreements.

The **involved stakeholders** are the following:

- The Municipality
- A consortium (Consorzio Eco 15), whose shareholders are Social Housing Cooperatives, Building Cooperatives and construction companies.

The **main services** provided are water, heating, sanitary hot water, electricity.

Regarding the **applied business model**:

- The Municipality signed an agreement with *Consorzio Eco 15* to sell the properties where the maximum prices for the sale of houses/dwellings were defined.
- Consorzio ECO 15 will sell the buildings to private owners, according to the requirements set in the Agreement with the Municipality
- End users are the buildings private owners and/or property managers in case of multi-family buildings, without any intermediate service providers.
- The Public Utility company managing the district heating in Brescia has a responsibility up to the district-heating sub-station; after the substation the plants are managed by owners and / or

property managers (for multi-family buildings) which may stipulate contracts with maintenance service companies or engineers.

### **A case of biomass district heating in rural areas: Borbera Valley**

In Borbera Valley, a rural area in the North West of Italy, an interesting case of biomass district heating system was conceived and developed. The project started in 2000 and aimed at sustaining local economy through the wood-energy chain, by installing biomass boilers fed with local forestry, parks and gardens maintenance residues, sawmills residues and providing the heat produced to some municipalities.

The **main stakeholders** involved in this project are:

- The Local authority with responsibility of forest management (Comunità montana)
- Three small Municipalities
- The forest owners who are members of a Cooperative (FOREST) dealing with the supply of forestry biomass
- A public/private company dealing with collection and management of biomass, whose shareholders are the “Comunità Montana”, the municipalities involved in the project and FOREST Cooperative.

The **main service provided** is district heating. The goal is to provide thermal energy from renewable sources (biomass) in an economic way, providing a full “thermal service” compared to selling of m3 of natural gas

Regarding to the **business model**:

- The Municipalities are part of the private/public company as co-founders, but are Clients too. In fact, the main end-users of the district heating are public buildings owned by the three involved Municipalities. The municipalities also own the district heating network. They can sign agreements or service contracts with private companies for the management of the biomass production plants and the district heating network. The contract/agreement can foresee guarantees for the end-user, mainly to ensure continuity in the heating service.
- The public/private company was constituted to manage both the biomass boilers and the fuel supply chain. It signs annual contracts with its private partner, FOREST Cooperative. The contracts include ordinary maintenance of the boilers and fuel supply.
- The biomass suppliers are usually paid per volume of biomass provided, in order to simplify the procedures.

Concerning the **thermal energy tariffs**, they are usually kept 15-20% below the price of natural gas, which is considered the top benchmark. The tariff take into account the biomass plant management, day by day operations and the biomass cost.

Regarding the **financial sources**, European Structural funds were used to cover the biomass plants' installation costs. Any further investment on the plants is under responsibility of the Municipalities involved.

### **A case of private energy district: Milan airports**

A case of private energy district was also analyzed, namely the district heating system of Milan airports.

Two combined heat and power plants for the generation, supply and sale of electricity and heat were built:

- The plant at Malpensa Airport produces electricity, heat and chilled water: the electricity is partially sold through the national grid, while heat and chilled water are used inside the terminal, to meet energy demand of the large airport structures and of other private users nearby the airport (e.g. hotels) by optimizing the exploitation of the flexibility of the trigeneration plant.
- The plant at Linate Airport provides heating and electricity to the Airport. For a number of years now, the district heating system serving the airport has been flanked by another providing heat to a wide urban area in the east side of Milan.

The main **stakeholders involved** are the following:

- Municipality of Milano
- A private Service company which manages/maintains the cogeneration plants and produces electricity, heat and cooling.
- End users (Municipalities and private users nearby the airports)
- Other potential customers for energy supplied by the Airports' plants (e.g. shipping and other service companies)

The **business model** is based on a private law subject (a Service company, whose activity purpose is in constructing and operating energy production facilities) that operates on an exclusive basis for the Milan Airports, for which it produces electricity, heat and cooling. The Service company also has the possibility to sell the energy produced to third parties. It, thus, makes commercial offers for the supply of heat (typically based on the avoided cost of fuel) to various parties (industry and services) operating nearby the airports, especially those that are located along lines of development of district heating grids and thus could be easily connected. The project was financed via private funds.

Additional information on case interviews can be found in the Annex J of this report.

## Workshop/interview results Netherlands

In the Netherlands several workshops and interviews were held both by ECN and by TNO. Three workshops and three additional interviews were held to create insight in possibilities for improvement when creating smart grids as can be learned from the different cases Couperus, Hoogkerk and EVA-Lanxmeer:

### 1 – interview to explore experiences in the Couperus-case

The Couperus project in The Hague consists of about 300 dwellings. Heat pumps are used for heating in combination with ground source collectors. The whole complex can be directed in its demand for heating by postponing the demand without the inhabitants noticing. This allows the balance responsible party to steer electricity demand for the heat pumps. They have in fact a virtual power plant. It is possible to deliver heat to the coldest dwellings first. Agreements were made on preconditions and timeframe in which the demand can be altered.

### 2 – interview to explore experiences in the Hoogkerk-case

The PowerMatching City, operating since 2010, consists of 25 interconnected household equipped with micro cogeneration units, hybrid heat pumps, solar panels, smart grid appliances and electric vehicles. Additional power is produced by a wind farm and a gas turbine. The aim of this project is to develop a market model for a smart grid under normal operating conditions. The underlying coordination mechanism is based on the PowerMatcher, a software tool used to balance energy demand and use. The aim is to extend this coordination mechanism in such a way that it can support simultaneous optimization of the goals of different stakeholders: in home optimization for the prosumer, reduce network load for the distribution system operator and reduce imbalance for program responsible utilities.

### 3 – interview to explore experiences in the EVA-Lanxmeer

The residents that initiated the build of the sustainable neighbourhood EVA-Lanxmeer bought the thermal network from their water company. This thermal network provided their houses (170 dwellings) some companies and public organizations (5 additional buildings) with heat. The water company put the thermal network on sale since it did no longer fit in their corporate strategy. The residents were already involved in all kinds of sustainability issues of their neighbourhood and were worried the new owner might increase the rates considerably. Residents are free to financially participate in their new energy company. The network was extended to an additional neighbourhood.

The following workshops were held:

- 1 Workshop on new scenarios for smart electricity grids– from the supply-side

The point of departure for this workshop was to think of a new set-up for the electricity system in the Netherlands in order to facilitate DE initiatives. Main questions are relevant if current standards are adequate or if the incentives need to be modified. Goal of the setting was to explore the possibilities for steering when facilitating the developments of regional and local networks while realizing the societal benefits of smart grids. The basic assumptions were that on a regional level people should be free to make their own choices and that economic principles can be used to steer people to preferable outcomes.

## 2 Workshop the demand-side

A workshop with two parallel brainstorm sessions were held; one with people from the perspective of people in local initiatives and one session from the perspective of parties supporting or facilitating local initiatives. Goals were to explore desirable scenarios and wishes, opportunities and possibilities for products and services in the future intelligent energy system.

## 3 Workshop with a municipality

Goals were the further clarification of interests, role of the municipality and identification of new opportunities.

## Conclusions from the interviews & workshops

The conclusions of the workshops and the interviews are clustered under the following headlines: possible scenarios, needs & drivers, roles & responsibilities, barriers & risks, price mechanisms, barriers & risks and opportunities products & services. The most important conclusions can be found here. Additional information can be found in the Annex K of this report.

## POSSIBLE SCENARIO'S FOR A FUTURE ENERGY SYSTEM

A focus on local market could lead to a different focus per region. In Brabant chicken manure could be chosen as fuel for the generation of heat and electricity, when Rotterdam could chose for rest heat from industry. This will lead to different products and services in the regions. Also standards might vary across the different regions. Some regions might chose for 12 V DC will others will keep their net to 220 V AC. In order to facilitate this, regional networks have to be build and disconnected. The regional networks have to be connected to the national network, preferable with a DC connection.

Local energy supply is important, but we must have a broader look at interaction on various scales, from local to national and even European in order to be able to match demand and supply. Holistic approach (with the ideal of Hoonhorst and Hoogkerk) is important, from a smart city to a smart country and smart Europe. The whole system and all energy forms (gas, electricity, heat, cold and mobility) should be taken into account.

A conclusion drawn is that there seem to be two options in order to deal with the fluctuation between supply and demand of energy: to invest in smart grids in order to balance the supply and demand or to invest in energy reduction (and buffering) in order to keep the peaks well below the current network capacity.

## NEEDS & DRIVERS

There is an emerging tendency among consumers to invest in private energy generation. During the workshop from the supply-side someone claimed the percentage of people interested lays around 10%. In other markets you see consumers are mainly interested in convenience.



Reasons to start local bottom-up initiatives:

- concern about energy prices or exploitation costs dwellings in the future
- to improve the quality of the community
- to improve social cohesion (especially in areas with declining population)
- the urge to do something together (is considered great fun!)
- as a means to jointly save energy
- control over own energy supply
- concern about the environment
- People are not satisfied about how large energy suppliers work. One pointed out that during the liberalization of energy market, a lot went wrong. Companies were not used to clients changing over to other suppliers. Now these companies have become anonymous entities driven to maximize profit some people feel the need for an alternative which allows for people to be involved themselves.
- A group has more power than an individual and energy supply for a group can be more efficient.

Municipalities are setting goals to improve sustainability and / or reduce climate effects. It is no longer possible to realize the set of goals on your own as a municipality. While the attention used to lay on actions the municipality could initiate themselves, it now depends on the situation what role is taken.

Housing cooperations have the need to distinguish themselves from their competitors and to address the most important driver for renters: to manage their living expenses. In the future energy expenses are expected to rise, therefore solutions are sought to control these. Another need is to find ways to actively involve renters.

## **ROLES & RESPONSIBILITIES**

Decentralised energy generation, which is currently rolled out on a large scale, requires much more active roles of different parties who have remained passive up to now. Current developments lead to changes in roles and responsibilities of existing parties. New parties are also joining in especially:

- Local initiatives
- Parties supporting local initiatives will emerge.

## **BARRIERS & RISKS**

The nature of risks involved are related to very different aspects. To give some examples for experiments:

- Include insufficient support from residents or collapse from the available social infrastructure during an experiment
- An incomplete overview of the situation at the start makes it difficult to indicate progress made in the project.
- When experimenting with new equipment the question emerges how to deal with the guarantee of appliances, have they been tested? Are they functioning properly?
- Care should be taken that innovative solutions that are tested in practice do not break the law.
- Some examples for local initiatives:
- In local initiatives the competence of people can be a problem
- A hostile take-over can be a risk for local initiatives
- The energy market is very complicated and it is not easy to earn money in this sector
- The current system is not tailored for local initiatives.
- The success factor is often, also at the organisations and authorities, the influence of enthusiast individuals. This is immediately a big risk, too, since when this person stops, the continuation of the initiative can be in danger.

- Authorities have different interests to look after and have a different pace. A local energy initiative therefore recommends not to involve authorities directly in the initiative.

There are many barriers when starting a local initiative. For example legislation and regulations, granting of permits (insufficient knowledge of civil servants/officers), intermediary parties (for example tenants think that the lessors should take the initiative). Another barrier is that often there is a lot of knowledge of procedures or technical issues, but not at the right place and time.

### **PRICE MECHANISM & RATES**

Current pricing mechanism is no longer valid, and should be changed. How the pricing mechanism should look like is not clear yet. At least it should enable people to consume and produce. Network managers should stimulate buffering. In case energy prices increase dramatically everything will change. Only then options that are now obscure will become interesting, like timing the wash machine with automatic means. Price incentives are too low at the moment.

### **OPPORTUNITIES, PRODUCTS & SERVICES**

Ideas for products & services:

1. Look at possibilities for value-adding instead of selling plain energy. This leads to new products and services: charge-my-car, ESCO-services etc.
2. a minimum energy package with the risk that energy is not available on certain hours
3. sell shares in the production of energy
4. a case manager who would advise and support local initiative by searching for the right expertise and help with procedures.
5. The TSOs (transmission system operator) like to have small units they can use to balance supply and demand. This means local initiatives can see themselves as a product or service.

Opportunities to improve preconditions for energy networks (thermal & electricity):

- Changing the legal rules.
- To embed economic principles into the energy system. Incentives to improve the system are lacking since costs are socialized.
- Changing the current obligation to connect everyone to the main grid.
- Clarification of outcomes for the dwellers.
- Repairing fragmentation in construction.
- Knowledge distribution.
- Access to finance & information on how to apply for finance.

## **3.3. Conclusions and summary of workshops and interviews**

Workshops and interviews were carried out in Belgium, Finland, Italy and in the Netherlands in order to clarify the current business models and services of identified project cases relevant to local energy services (E-HUB) and to innovate new business and service models.

Markets and needs will change. Local energy supply is important, but we must have a broader look at interaction on various scales, from local to national and even European in order to be able to match demand and supply. Holistic approach is important, from a smart city to a smart country and smart Europe. The whole system and all energy forms (gas, electricity, heat, cold and mobility) should be taken into account. Distributed generation at district level is gaining importance although most distributed generation is currently being installed at building level .

The established energy businesses like for instance, district heating popular in the Nordic countries but penetrating in the other European countries as well will face challenges in order to be competitive in the future due to low and passive energy construction will become a practice (Finland, Belgium). New services (e.g. smart metering of heat) and pricing systems, financing models, new technologies like hybrid heating systems are requested by the markets.

Further, introduction of financial support to switching to district heating (Sweden, Germany, Finland, Belgium) may improve the competitiveness of district heating. High connection fee has been identified as an important barrier for the customers to choose district heating, and new pricing models could be used to reduce this problem (for example lengthening the payment time or providing an option of renting the heat distribution centre). Additional energy services as district cooling may make DH more attractive (e.g. the Turin project). Offering bundled services, including energy consumption information (which can be seen freely by everyone) and user can sign in to see their own specific energy consumption data.

Interests, roles and needs of stakeholders in energy service business are changing:

- Current developments lead to **changes in roles and responsibilities** of existing parties
- There is an emerging tendency among **consumers** to invest in private energy generation. This is also supported by the web questionnaire.
- **The role of the municipality** is changing. It is no longer possible to realize the set of goals on your own as a municipality. While the attention used to lay on actions the municipality could initiate themselves, it now depends on the situation what role is taken. The municipality used to formulate environmental goals as a separate policy line. People do not want to be patronized by organisations or the government and be dependent, but they want more and often to decide themselves on their surroundings and ways to take an action. People wish to be involved in the decision process already in the early stages. In a town/city, the local lower authorities or housing cooperations could/should get involved. Also activation and integration of community is included. Residents are interested about what is going on in the residential area.
- **Parties supporting local initiatives** will emerge. Further new players often find a position between the end user and the energy supplier/grid operator, and new businesses are created
- **Service designers** and psychologists emphasize, that product and service concepts should be simple, usable and appeal to people. Social sharing and visualization usually helps. There are models in which end customers see their consumption compared to a similar household's average and people can get small rewards if their energy consumption is less than average and they belong to group of top 10 % having lowest energy consumption (or highest energy efficiency).

Decentralized energy generation, which is currently rolled out on a large scale, requires much more active roles of different parties who have remained passive up to now. New parties are also joining in. Each stakeholder should have its own, clearly defined role. Program responsibility as we know it will disappear. There will be, however, a need for a regional planning function to determine the zoning for generation capacity for a period of e.g. the next 20 years. This can be filled in with concessions (PPP models).

The current system is not tailored for local initiatives. The process needs to be facilitated, people need to be guided, but this cannot be enforced. Developments in PV installations, for example, are progressing so rapidly at the moment that it is difficult to facilitate this from the central system. This requires high flexibility. One example is the smart meters: these are not functioning properly; the preparation takes five years.

Current pricing mechanism is no longer valid, and should be changed. Price incentives are too low at the moment. We should not so much look at different types of energy production only. An overview is needed where to the end-user requires energy: light, power, heat (high or low-value), mobility, cooling, and comfort. Also information has value. This may lead to new products and services: charge-my-car, ESCO-services, different regional network etc. A focus on local market could lead to a different focus per region.

It could be imaginable that a minimum energy package would be available for everyone with the risk that energy is not available on certain hours. A commercial party could offer you additional energy services against additional fees. Now there is no choice.

Often energy itself does not raise interest enough, a service provider has to include also other services as well to the offer . A key finding (Finland) is that **there is demand for turnkey solutions and some kind of service integrator**. End customers can't sort out all different technology providers, processes, licenses and subsidies. Thus there should be only one interface or service provider for end customer that deals with all that, and coordinates the processes with subcontractors and partners. Otherwise it is too complicated for the end customers. **New service design is needed to get consumers involved and willing to pay for new technologies**. Facilitators might emerge to help existing businesses with their smart solution transition, by providing information about business opportunities and enhancing collaboration between different industry actors.

## 4. Methods for identification of potential non-technical barriers and risks for new business and service models

This section presents the methods for analysis of the risks, sharing principles and mitigation of risks.

### 4.1. Introduction to risk management methods

The target of risk analysis is to define risk targets, probability and magnitude of risk, as well as impacts following from the risk. Furthermore, these can be followed by risk management and pinpointing the responsible party. **Risk analysis** can be divided into following main steps:

- 1) Defining the target,
- 2) Recognizing risks,
- 3) Evaluation of risks: (assessing magnitude, probability and consequences of the risk)
- 4) Assessing the total risk,
- 5) Risk management (for avoiding or minimising the risk): removing, reducing, and preventing the risk (e.g. by transferring it to other stakeholder, insuring, or at one's own risk)

Usually it is best to give **the responsibility of the risk to the party, who has the best qualifications to bear the risks (with smallest impacts), in addition to, which party the risks naturally belong to**. For example, typically a building owner (or a resident) would be responsible for risks related to the effective usage of spaces, energy consumption risks and energy price risks, whereas a supplier would take the responsibility about risks related to design, construction and maintenance. Drafting a contract is a concrete tool for pinpointing the party responsible for risks. Through risk assessment, crucial matters to be included in the contracts are observed along with the necessary insurances and potential securities. Methods for risk allocation are presented in the following chapters, and they can support risk negotiations, when pinpointing the responsibilities between the parties.

Risk has two dimensions: probability and impact. A risk, which probability cannot be estimated, is referred as uncertainty. Uncertainty is typically a sign of insufficient knowledge, and therefore it is a part of risks, which are difficult to evaluate with probabilities.

### 4.2. Risk identification and categorisation

Risks can be identified and classified with many principles. Typically they are based on a checklist (or matrix) of risks.

One option is a meta-classification approach, which has three levels of risk factors for projects: macro, meso and micro level risks. The advantage of this classification method is that it facilitates a strategic approach to risk management for both public and private sectors. The sublevels of meta-classification are presented in annexes 1. (L. Bing et al, 2005)

**Meta-classification levels for risk identification** [L. Bing et al, 2005]:

- 1) The Macro level: risks external to the project, such as national or industry level status and natural risks. Political and legal, economic and social condition and weather.
- 2) the Meso level: risks within the project, such as implementation problems (project demand and usage, location, design, construction and technology, quality, delays)
- 3) the Micro level: risks in the stakeholders' relationships (relationship and third party: organisation and co-ordination, inadequate distribution of risks, differences in working method, staff crises)

Some of the risks should still be retained within the public sector or shared with the private sector. Bing et al (2005) suggest that the majority of risks (up to 70 % of risks) in PPP/PFI projects should preferably be allocated to the private sector. Typically, the risks retained by the public sector would be in Macro level:

nationalisation/ expropriation, poor political decision-making process, political opposition and government stability, in addition to meso level risk of site availability. Some risks should be shared - at macro level: risks force majeure and legislation change; and in micro level: lack of commitment from a partner, responsibilities and risk distribution and authority distribution between partners. Moreover, some risks are primarily assigned to the primary sector, but with perceived opportunities for sharing those with public sector, such as following macro level risks: tax regulation change, inflation, the tradition of private provision of public service and influential economic events. Also meso level risks should be shared: late design changes, residual risks, the financial attraction of project and level of demand; and in micro level: staff crisis, third party tort liability and different working methods. The allocation of some risks strongly depends on the specific circumstances.

Another method for **risk classification** is presented by Räsänen (Räsänen 2004) to three classes:

- 1) Country related risks (economic and political risks, natural conditions)
- 2) Implementation risks (technical, financial, contractual and personnel risks)
- 3) Force Majeure risks (unforeseen risks, which are not possible to remove).

This classification is similar to the previous meta-classification approach, except for the third level, which focuses on stakeholders relationships.

### 4.3. Risk allocation process

Risks can be shared with risk allocation agreement between direct partners of projects. Some risks can be shared, in which case each stakeholder bears a certain risk outcome. The financial risk allocation agreement is reached along with overall contract agreement. The process of negotiation for risk allocation is presented in Figure 15. After agreeing on risk allocation, stakeholders can continue on to the risk treatment stage in contract management. Identifying risks and stakeholder's preferences about risk allocation facilitates the process. [L. Bing et al, 2005]

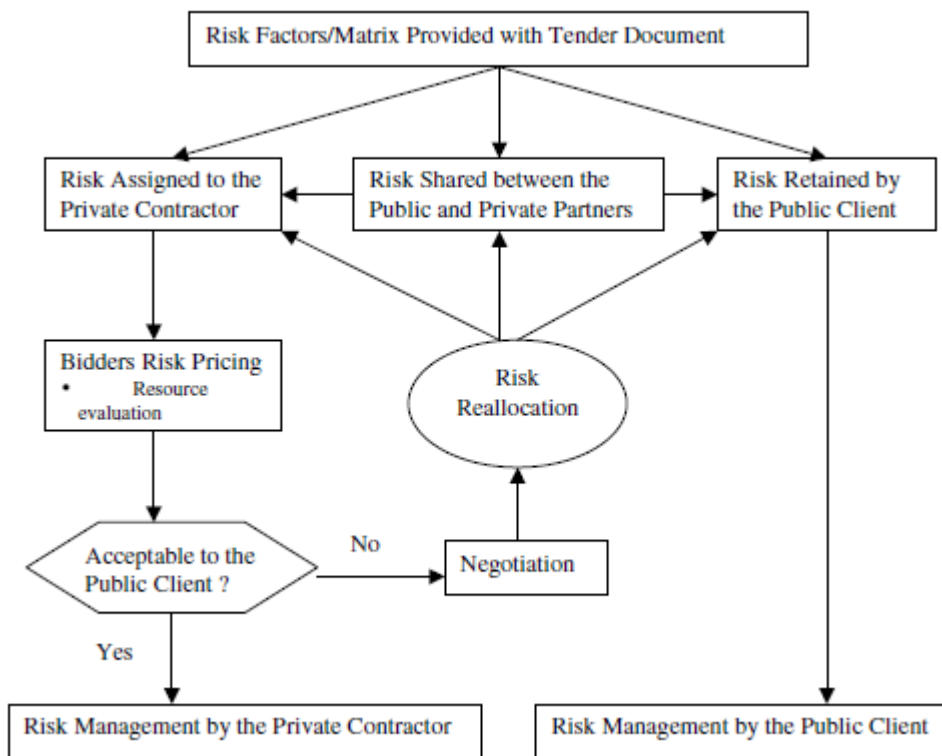


Figure 15: **Risk allocation process in PPP/PFI contract procurement (Bing et al 2005)**

Heimonen et al (2007) present one practical method for systematic risk assessment proposing a **risk sharing table** for case study of building service systems. The example picture of risk sharing table is presented in Figure 16, and the complete table can be found in annex G. The potential (along with

apparently impossible) risks are listed and shown to the project parties. Risks are categorised into macro, meso and micro levels (according to meta-classification approach by Bing et al 2005). With the risk sharing table, the parties share the responsibilities for the risks each party will assume. The responsibility for an individual risk is left to either party or to both parties according to principles agreed by the parties. The client assesses the risks of the project and assumes responsibility for some of the parties involved in the project. In the invitation for bids, the bidder is asked to pay attention to the risks transferred to the provider and to describe how they will assume responsibility for the risks or will take these into account in the bid. In practise, the provider may not necessarily take the responsibility of all risks offered but will transfer the risk back to the client in the bid. The responsibility for a risk will naturally have influence in pricing – the party taking the responsibility of the risk is setting a price for the risk. [Heimonen et al, 2007]

Main	Sub category	Risk factor	Risk allocation		
			Client	Bidder	Shared
A. Macro level risks					
	Political and government policies	B. Meso level risks	Risk allocation		
	_ Unstable government	Project selection	Client	Bidder	Shared
	_ Expropriation or nationalisation	_ Land acquisition (site availability)			
	_ Poor public decision making	_ Level of demand for project			
	_ Strong political opposition	Project finance			
	Macroeconomic	_ Availability of finance			
	_ Poor financial market	_ Financial attraction of project to investors			
	_ Inflation rate volatility	_ High finance costs			
	_ Interest rate volatility	Residual risk			
	_ Influential economic events	_ Residual risks			
	Legal	Design			
	_ Legislation change	_ Delay in project approvals and permits			
	_ Change in tax regulation	_ Design deficiency			
	_ Industrial regulatory changes	_ Unproven engineering techniques			
	Social	Construction			
	_ Lack of tradition of public services	_ Construction cost overrun			
	_ Level of public opposition	_ Construction time delay			
	Natural	_ Material/labour availability			
	_ Force majeure	_ Late design changes			
	_ Geotechnical conditions	_ Poor quality workmanship			
	_ Weather	_ Excessive contract variation			
	_ Environment	_ Insolvency/default of sub-contractors or suppliers			
		Operation			
		_ Operation cost overrun			
		_ Operational revenues below expectation			
		_ Low operating productivity			
		_ Maintenance costs higher than expected			
		_ Maintenance more frequent than expected			

Figure 16. An example of risk allocation tables (Immonen, 2006)

The risk assessment table helps the bidders in evaluating how they accept the risks the client is transferring to the provider. The table forms a foundation for the bidders' proposition in order to show how well the bidders understand the nature of the risk, how effectively the bidders forward or share the risks in

the subcontractor chain, and how the bidders minimize the unfavourable effects caused by risks in relation to the client and the end users.

#### 4.4. Critical Success Factors

In addition to evaluating risks of a project, also evaluation of Critical Success Factors (CSF) can be useful. A number of factors are combined to determine the success or failure of an infrastructure project in terms of its objectives for example cost, time, and quality. The CSFs can be identified based either on quantitative measures or on expert opinions (Chua et al. 1999], Zhang 2005)

The main categories of critical success factors (CSF) are, according to Zhang (2005):

- 1) Favourable investment environment - The willingness of private sector investors and lenders to develop public infrastructure projects depending greatly on the environment where the project is operating.
- 2) Economic viability- Traditionally, four methods have been used for financial viability evaluation by Zhang, namely payback period, discounted payback period, net present value, and internal rate of return methods.
- 3) Reliable concessionaire consortium with strong technical strength - Selection of the right concessionaire is critical to the success of the project. This can be realized through a competitive tendering process.
- 4) Sound financial package – A sound financial package should include the following features: sound financial analysis; sensible schedules for investment, payment, and drawdown; appropriate combination of financing sources and standby facilities; stable currencies of debts and equity finance; high equity–debt ratio; low financial charges; fixed and low interest rate financing; long-term debt financing that minimizes refinancing risk; ability to deal with fluctuations in interest and exchange rates; and appropriate payment structures.
- 5) Appropriate risk allocation via reliable contractual arrangements - Includes many factors such as clear statement of the objectives of the contract and the obligations and rights of the contracting parties, adequacy and clarity of plans and technical specifications, a formal dispute resolution process, and motivation and incentives to the contracting parties (Chua et al. 1999).

The subcategories of critical success factors are listed in annex G.

#### 4.5. Risk analysis in the financing sector

In the financial sector, risk is mainly related to the possibility that the cash flow of an issuer will not be adequate to meet its financial obligations. This kind of risk can arise from an organization's exposure to financial markets, its transactions with others stakeholders and its reliance on processes, systems and people. It can assume three main forms:

##### **A. Credit risk**

This is the risk that a counterparty will not meet an obligation when due and will never be able to meet that obligation for full value. The bankruptcy of counterparty is often associated with such difficulties, but there may be other causes as well.

##### **B. Market risk**

Market risk can be defined as the possibility of loss caused by changes in the market variables. It can assume different forms, such as:

- *Liquidity risk*

This is the risk that payments will not be made when due, even though one or more counterparties have sufficient assets to make them. For example, liquidity problems can be generated by a temporary inability to convert assets to cash or operational difficulties of various kinds.

- *Interest rate risk*

The interest rate risk is associated with the effects of changes in market interest rates. Interest rates usually include the real rate plus a component for expected inflation and a risk premium to reflect the creditworthiness of a borrower. They also reflect supply and demand for funds. Interest rates represent the



key ingredient in the cost of capital: when they increase, the impact can be significant on borrowers. Factors that influence the level of market interest rates include expected levels of inflation, general economic conditions, monetary policies, foreign exchange market activity, levels of sovereign debt outstanding.

- *Foreign exchange risk*

The foreign exchange risk is related to potential changes in the foreign exchange value of a currency. Foreign exchange rates are determined by supply and demand for currencies. Supply and demand, in turn, are influenced by factors such as foreign trade and capital flows. Other factors that can affect exchange rates include: financial and political stability, monetary policy, interest rate differentials, trading activity in other currencies and domestic debt levels (e.g., debt-to-GDP ratio).

- *Inflation risk*

The inflation risk refers to the loss of purchasing power due to the effects of inflation. When inflation is present, the currency loses its value due to the rising price level in the economy. The higher the inflation rate, the faster the money loses its value. Any investment that involves cash flows over time is exposed to this inflation risk.

- *Country risk*

Country risk arises from the possibility that a Country will be unable to service or repay debts to foreign lenders on time. Country risk usually occurs when a government takes over the assets of the investor (like in the case of nationalization) and prevents discharge of liabilities. It is more and more frequent due to the increase of cross border transactions.

### **C. Operational risk**

Operational risk can be defined as the risk of loss arising from inadequate or failed internal processes, people and systems or from external events (such as natural, political or military events, deficiencies in the technical infrastructure, as well as changes in and problems with the legal, tax and regulatory environment). It can include not only direct financial losses but also the indirect ones deriving from the loss of external reputation and market value.

Each type of risk can generate expected losses (it is the amount expected to be lost due to changes in credit quality resulting in default) and unexpected losses (losses resulting from unexpected events). Generally, expected losses are borne by the borrower, through the payment of a risk premium to the financial institution, while unexpected losses are entirely borne by the bank itself, via specific capital allocation.

The essential functions of risk management in the financial sector shows five basic components:

1. Identification of risk
2. assessment of risk to classify it and to seek solutions
3. quick response and implementation of solutions
4. monitoring of the risk management progress
5. learning from this experience and ensuring it never occurs again

Concerning **credit risk**, it is usually managed by setting prudent limits for exposures to individual transaction, counterparties and portfolios. Credit risk management usually includes:

- *Monitoring of per party exposure / group exposure / bank's exposure in contingent liabilities*

Exposure ceilings linked to the Capital Funds of the bank must be established.

- *Measurement through credit rating/scoring*

Each financial institution usually sets up a comprehensive risk scoring system, clearly defines rating thresholds and periodically reviews the ratings.

- *Pricing on a scientific basis*

Loan pricing must be linked to the expected loss and high-risk category borrowers are priced higher than others.

- *Quantification through effective Loan Review Mechanism and Portfolio management*

Loan Review mechanisms are credit audits covering review of sanction procedures, compliance status, review of risk rating and recommendation of corrective actions with the objective of improving the credit quality. Credit portfolio management entails to establish quantitative ceiling on aggregate exposure on specific rating categories, distribution of borrowers in various industries and business groups.

**Credit risk is measured by banks via two main indicators: Probability of Default (POD) and Loss Given Default (LGD).** The first one represents the probability of default associated with borrowers in each

of the rating categories, whilst the second represents the amount the bank would lose if a default occurs. The LGD also depends upon Exposure at Default (EaD), which is the bank's exposure to the borrower at the time of default.

In order to manage **market risks**, an Asset Liability Management (ALM) is usually set up by the bank as a part of its overall risk management system. ALM ensures examination of all the assets and liabilities simultaneously on a continuous basis with a view to guarantee a proper balance between funds mobilization and their deployment with respect to their a) maturity profiles, b) cost, c) yield, d) risk exposure, etc. It includes product pricing for deposits as well as advances, and the desired maturity profile of assets and liabilities.

A widespread methodology used to assess the market risk is the '**Value at Risk (VaR)**', a statistical assessment of risk exposure which measures the worst expected loss over a given interval time under normal market conditions and at a given confidence level.

Regarding **country risk**, financial institutions usually take into account both direct and indirect exposure, such as the exposure to a domestic commercial borrower with large economic dependence on a certain foreign country. Direct and indirect exposure are then computed on a net basis (i.e. gross exposure minus collaterals, guarantees etc.) and monitored. Banks often set up their own systems to assess country risks, and in this case they do not rely only on rating agencies or external sources, but they develop internal methods and sources of evaluation.

To manage the **operational risk**, financial organizations usually put in place internal control or internal audit systems, as well as risk education at all levels of staff.

**The main step to handle operational risks in financial institutions** can be summarized as follows:

- Creation of a formal organization of operational risk management, which clarifies competencies and responsibilities of business areas and hierarchy levels within the bank. An important first step in this direction is the systematic reporting of operational risks up through the hierarchy to the level of the board of directors.
- Inclusion of operational risks in an overall risk management concept.
- Development and implementation of tools for operational risk management. There are currently five main tools: (1) self-assessment (2) risk mapping (3) risk indicators (4) escalation triggers (5) loss event scenarios.
- Inclusion of operational risk management in a value-oriented global management concept.
- Adoption of insurance solutions for operational risks or instruments of contingent capital (funds that would be available under a pre-negotiated agreement if a specific contingency, such as a natural disaster, occurs).

#### 4.6. Risk analysis methods used in district development projects

During this literature analysis, it was realized that the typical risks associated with district development projects were not easily available as scientific articles. Also according to our experiences, risk analysis has been typically been practiced within the stakeholder groups (inside the project) through questionnaires etc. and is often inaccessible for outside parties. One case study method and results of risk analysis is reported in next section.

#### Case Kaivomestari, Espoo, Finland: Allocation of risks

City of Espoo implemented in 2006 a project called Kaivomestari [Rahunen, 2008; Immonen 2006]. It was a life cycle project, with offering both school and sport services for the residents. Private project company Arandur Oy was responsible for planning of the project, being the building developer and owner of the buildings; and for the maintenance, as its customer had defined. City of Espoo is the customer, which buys the Kaivomestari facilities for the needed time. Other times Arandur Oy can rent the spaces to someone else. In addition, Arandur took also care of the arranging the financing for the investment and producing the services that are offered in Kaivomestari, excluding only teaching and planning of exercise services, which are done by the city of Espoo. Arandur has to produce the services with the quality level as agreed on the service contract with city of Espoo. In return, city of Espoo pays service payment to Arandur. The project started in 2001 with signing a service contract and Kaivomestari was built in 2003.

The services of Kaivomestari provide high school, sport and swimming hall and some community spaces. The overall floor area of Kaivomestari is 11 000 m<sup>2</sup>. Arandur was founded by three companies, providing construction company, catering company and building technical systems company. The length of service contract is 25 years. Figure 17 presents the organisation and interactions of the client and service providers in Kaivomestari case

Arandur bears most of the risks, which it has been further tended to move to subcontractors (even though it has responsibility even from the actions of subcontractors). Risks of the project company were: construction, maintenance and renovation, quantity and quality of services, usability of spaces, usage amounts and economic trends. On the other hand, City of Espoo bears among others the risks of fixed service fee, its customers (including students), changes in the law, force majeure and reconstruction. [Rahunen, 2008]

It seems that in the overall the usage of this kind of model in the Kaivomestari case has cost to the city of Espoo a bit more than traditional model would have cost, partly due to the financing decisions. In the future projects the financing risks should be assessed better. [Rahunen, 2008]

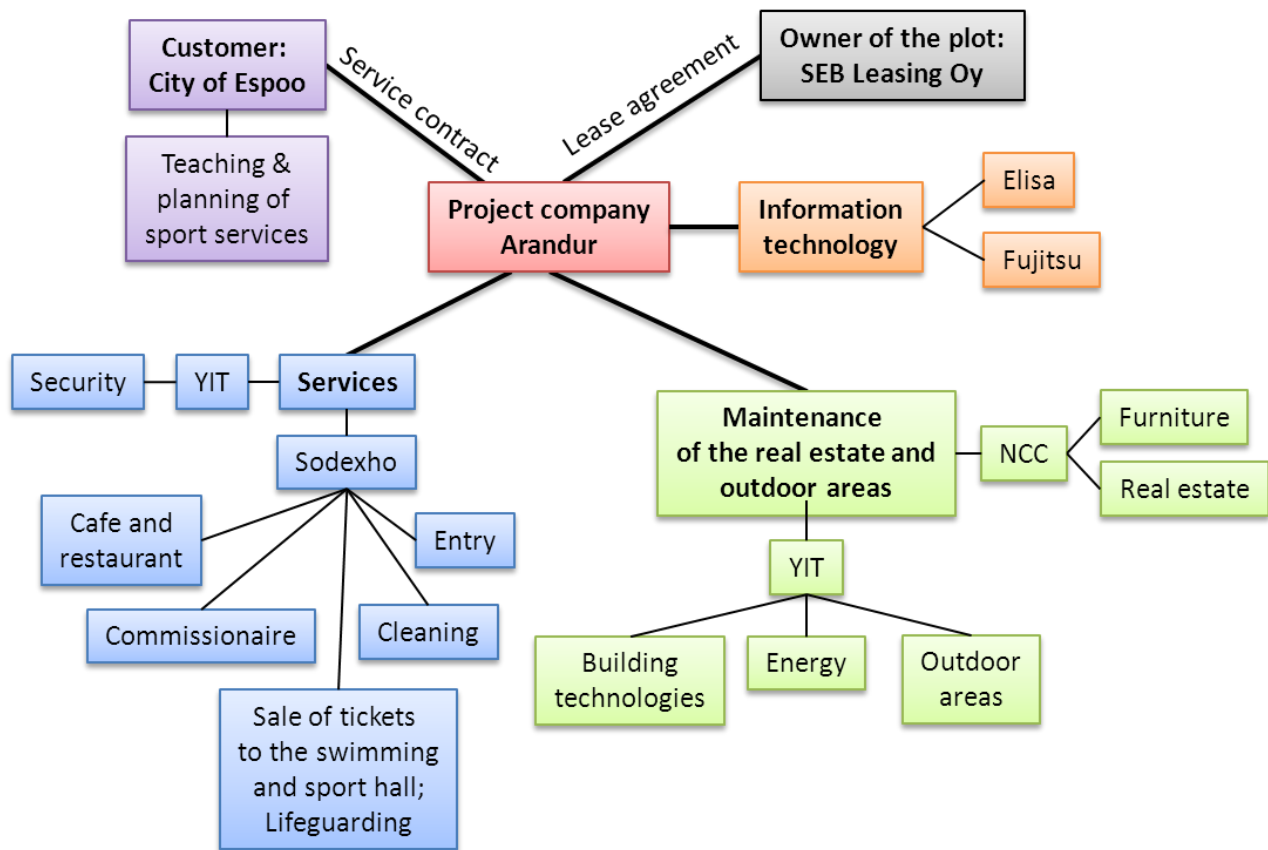


Figure 17. Stakeholders of their relationships in the Kaivomestari case [Modified from Rahunen 2008].

Immonen made a risk analysis for the Kaivomestari with representatives from customer (City of Espoo) and tenderer (Arandur Oy). At first a questionnaire was sent to name 5 main success factors and 5 main risks of the project. These were based on the critical success factors method, which is presented in chapter 4.4. (and in annex G). In this analysis the factors listed were adapted to the Kaivomestari case. [Immonen, 2006]

In the second phase of the risk analysis stakeholders were interviewed to clarify the reasons for the results of the first questionnaire. And finally the stakeholders' opinions about risk sharing were surveyed. This was done by asking stakeholders to fulfil risk allocation tables, in which they assessed how significant each risk would be, and how the risks should be shared between the stakeholders. The risk sharing tables were based on the method presented in chapter 4.3. (and in annex G), and again these were modified specifically into the Kaivomestari case. [Immonen, 2006]

The results of the questionnaires and interviews were then summarised. The opinions about critical success factors and risks of customers and tenderers were compared. The risk allocation tables were also combined, resulting an overview table about how stakeholders would execute the risk allocation. In this case, the project was already on-going and contracts signed, but based on this study it seems that these methods are appropriate for risk analysis. This kind of risk analysis could help e.g. contract negotiations by understanding easier the opinion of each stakeholder. [Immonen, 2006]

#### 4.7. Recommendations and tools for E-HUB risk analysis methods

Section 4 gives an overview of risk management process and presents the basics for identification and categorisation of the risks. The risks of financing energy related projects are presented. This description of possible risks gives background for the detailed analysis in the specified project case. The risk matrix approach is simple method for helping in risk sharing between client and service provider. It is recommended to make specific version of the risk matrix for each district energy project. The critical success factor methods is presented as a tool for improving the success of the projects. The risk allocation process including stakeholders in case "Kaivomestari" school and swimming hall area was presented as example of district level project risk allocation.

## 5. Summary and conclusions

An analysis of the markets and needs of energy services was performed in the first subtask, including an overview of the stakeholders in different types of energy networks. The services needed by different stakeholders are analysed and business ideas and driving forces for different stakeholders are described. The state-of-the-art analysis is done by literature reviews, questionnaires and interviews. The work is based on the background paper D6.6 of WP6, which gave a common understanding of topic services, business models and value chains; as well as the description of terminology

In order to better understand the some basic information of projects relevant in the E-HUB scope were collected by the partners. Altogether 20 projects were identified by the partners. Even if the number of identified project cases were relatively low, there are a lot of research and piloting activities on-going in Europe. Further the scope of services offered was rather traditional- mainly heating and cooling and in some cases management services were offered. In contrary the technology scope varied: solar, biomass, geothermal energy, waste to energy, heat pumps, tri- gen plants, wind turbines, micro CHP:s as energy generators.

The most common business model was the PPP model that indicates that the public sector has an important role in introducing new energy service solutions. There were a case (Italy) where co-operatives participated to energy production in the role of biofuel suppliers. The reported cases indicate clearly that the maturity, penetration and application of different energy technologies vary a lot country by country. For instance district heating and cooling solutions are “business as usual” case in the northern Europe while still very rare in the southern European countries. Some of the identified district energy projects whose service offering, business models and technology scope were selected for further analysis. The analysis of the existing and alternative new energy service concepts and content was performed by workshops and interviews.

Workshops and interviews were carried out in Belgium, Finland, Italy and in the Netherlands in order to clarify the current business models and services of identified project cases relevant to local energy services (E-HUB) and to innovate new business and service models. Markets and needs will change. Local energy supply is important, but we must have a broader look at interaction on various scales, from local to national and even European in order to be able to match demand and supply. Holistic approach is important, from a smart city to a smart country and smart Europe. The whole system and all energy forms (gas, electricity, heat, cold and mobility) should be taken into account. Distributed generation at district level is gaining importance although most distributed generation is currently being installed at building level.

Decentralised energy generation, which is currently rolled out on a large scale, requires much more active roles of different parties who have remained passive up to now. New parties are also joining in. Each stakeholder should have its own, clearly defined role. Program responsibility as we know it will disappear. There will be, however, a need for a regional planning function to determine the zoning for generation capacity for a period of e.g. the next 20 years. This can be filled in with concessions (PPP models).

The current system is not tailored for local initiatives. The process needs to be facilitated, people need to be guided, but this cannot be enforced. Developments in PV installations, for example, are progressing so rapidly at the moment that it is difficult to facilitate this from the central system. This requires high flexibility. One example is the smart meters: these are not functioning properly; the preparation takes five years.

Current pricing mechanism is no longer valid, and should be changed. Price incentives are too low at the moment. We should not so much look at different types of energy production only. An overview is needed where to the end-user requires energy: light, power, heat (high – or low-value), mobility, cooling, and comfort. Also information has value. This may lead to new products and services: charge-my-car, ESCO-services etc. Different regional network- A focus on local market could lead to a different focus per region.

It could be imaginable that a minimum energy package would be available for everyone with the risk that energy is not available on certain hours. A commercial party could offer you additional energy services against additional fees. Now there is no choice.

Often energy itself does not raise interest enough, a service provider has to include also other services as well to the offer. A key finding (Finland) is that there is demand for turnkey solutions and some kind of service integrator. End customers can't sort out all different technology providers, processes, licenses and subsidies. Thus there should be only one interface or service provider for end customer that deals with all that, and coordinates the processes with subcontractors and partners. Otherwise it is too complicated for the end customers. New service design is needed to get consumers involved and willing to pay for new technologies. Facilitators might emerge to help existing businesses with their smart solution transition, by providing information about business opportunities and enhancing collaboration between different industry actors.

The future visions of services & business based on *web questionnaire* is bundled services. The most potential new service created through smart energy solutions is, according to the respondents, bundled energy services. Also services regarding the control of energy consumption and energy costs are seen as a potential new service, besides energy efficiency services (ESCO). The non-end user stakeholder groups were also asked what kind of services they would like to sell. The most intriguing alternative was energy efficiency services (ESCO), but bundled energy services and services regarding energy consumption controlling were seen as interesting services to be sold by the stakeholders. The answers are in line with the respondents view on potential new services that could be created through smart energy solutions even if only roughly one third of the respondents are willing to sell new services.

Existing legislations, incentives and barriers for energy business and systems, e.g. E-HUB systems, renewable energy and smart energy grids, were presented. Energy Law in the Member State varies. At the European level, the activities of ESCO's are subject to obligations laid down in European Energy Law (Electricity Law and Gas Law). The Third Energy Package, including Directive 2003/54/EG for Electricity and Directive 2003/55/EG, are of special importance. These directives establish common rules for the generation, transmission, distribution and supply of electricity respectively gas. Member States must implement these obligations in their own legislation. For the rest, Member States are free to enact their own national legislation. The legislative aspects were presented for three relevant issues with respect to ESCOs: the ability for consumers to change supplier in all circumstances, transport tariffs and smart energy systems. The incentives and barriers for renewable energy, smart energy and E-HUB systems were presented and measures to overcome the barriers were discussed.

## 6. References

ADDRESS, 2009: Deliverable 1.1 Conceptual architecture including description of: participants, signals exchanged, markets and market interactions, overall expected system functional behaviour – Core document. ADDRESS project. FP7 – Cooperation / Energy.

Akintoye, A., Beck, C. & Hardcastle, C. 2003. Public Private Partnerships –Managing Risks and Opportunities. Blackwell, Oxford.

Zie G. Ault, D. Frame, N. Hughes en N. Strachan, Electricity Network Scenarios for Great Britain in 2050, Final Report for Ofgem's LENS Project, Ref.no. 157a/08, 2008;

Blom et al 2012, CE Delft en KEMA, Authors: M.J. (Martijn) Blom, M. (Mart) Bles, C. (Cor) Leguijt, F.J. (Frans) Rooijers, R. (Rob) van Gerwen, D. (Daan) van Hameren, F. (Frits) Verheij. Maatschappelijke kosten en baten van intelligente netten, Delft, januari 2012. The English summary "the social costs and benefits of smart grids" is available on [http://www.ce.nl/publicatie/maatschappelijke\\_kosten\\_en\\_baten\\_van\\_intelligente\\_netten/1236](http://www.ce.nl/publicatie/maatschappelijke_kosten_en_baten_van_intelligente_netten/1236)

Bing Li, Akintoye A., Edwards P.J., Hardcastle C. 2005: The allocation of risk in PPP/PFI construction projects in the UK. International Journal of Project Management 23 (2005) 25-35.

Boait, Peter, 2009: Energy Services and ESCOs – their benefits and implications for regulation and the consumer. Institute of Energy and Sustainable Development, De Montfort University. Report part of PRI-X@20 project.

Chua, D. K. H., Kog, Y. C., and Loh, P. K. (1999). Critical success factor for different project objectives. Journal of Construction Engineering and Management. 125(3) : 142-150.

COWI / EU Commission. Promoting Innovative Business Models with Environmental Benefits. Final report November 2008. 118 pages.

Eaton, D., Akbiyikli, R., Dickinson, M. 2006. An evaluation of the stimulants and impediments to innovation within PFI/PPP projects. Construction Innovation 2006 (6), pp. 63-77.

Energiateollisuus ry, 2011: Kaukolämmön hinta pähkinäkuoressa (in engl. The price of district heating in a nutshell).

Energy-An Consulting, 2009: Kaukolämmön hinnoittelumallit (in engl. Pricing models for district heating).

EU Directive 2006/32/EC on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC . Official Journal of the European Union . 2006. 22 pages.

European Commission Joint Research Centre Institute for Energy, 2010, 'Energy Service Companies Market in Europe, Status Report 2010'.

<http://publications.jrc.ec.europa.eu/repository/bitstream/11111111/15108/1/jrc59863%20real%20final%20esco%20report%202010.pdf>

Fortum, 2012: Perusmaksusta tehomaksuun. (in engl. From basic fee to power based fee) <http://www.fortum.com/countries/fi/yksityisasiakkaat/kaukolampo/tuotteet-ja-hinnat/perusmaksusta-tehomaksuun/pages/default.aspx>.



Fortum Power and Heat Oy, 2012: Kaukolämmön liittymishinnasto.(in engl. Connection fee list prices for district heating)

Hagström, Markku; Vanhanen, Juha; Vehviläinen, Iivo, 2009: Kevennetty kaukolämpötekniikka. Kustannustehokkaan jakelu- ja asiakasteknologian kehittäminen matalan kulutustason olosuhteisiin. (in engl. Lightweight technical solutions for district heating) Loppuraportti. Gaia Consulting Oy. Energiatoteutus ry:n tutkimushanke.

Gallimore, P., Williams, W. and Woodward, D. (1997) Perceptions of risk in the Private Finance Initiative, *Journal of Property Finance*, 8(2), pp. 164-176.

Heimonen, Ismo; Immonen, Iiro; Kauppinen, Timo; Nyman, Mikko; Junnonen, Juha-Matti. 2007: Risk management for planning and use of building service systems. CLIMA 2007 Well being Indoors, 9th REHVA World Congress, 10-14 June 2007, Helsinki. Proceedings, Vol. 3. FINVAC ry. Helsinki (2007), 485-494

Heimonen2: Heimonen, Ismo; Himanen, Mervi; Junnonen, Juha-Matti; Kurnitski, Jarek; Mikkola, Markku; Ryyänen, Tapani; Vuolle, Mika. 2007. Tools for life cycle models in building service technology. CLIMA 2007 Well being Indoors, 9th REHVA World Congress, 10-14 June 2007, Helsinki. Proceedings, Vol. 3. FINVAC ry, ss. 445-452

Immonen Iiro, 2006: Risks and success factors in construction life cycle service projects. Master's thesis, Helsinki university of technology. 103 pages + 2 Appendices. (Original language: Finnish)

Jyväskylän Energia Oy, Korpilahti district heating plant.  
<http://www.promobio.eu/tiedostot/tiedotteet/IEE%20Promobio%20Korpilahti%20fact%20sheet1.pdf>

Klessmann Corinna , Rathmann Anne Held, Max c, Ragwitz Mario, 2011: Status and perspectives of renewable energy policy and deployment in the European Union—What is needed to reach the 2020 targets? *Energy Policy*39(2011)7637–7657.

Klobut, Krzysztof; Heikkinen, Jorma; Shemeikka, Jari; Laitinen, Ari; Rämä, Miika & Sipilä, Kari, 2009: Huippuenergiatoteutuksen asuintalon kaukolämpöratkaisut. Espoo 2009. VTT Tiedotteita – Research Notes 2513.

Kohonen, R., Meronen, T., Heimonen, I. ,2011: Concepts, stakeholders and value chains in smart energy business and services. 2011. Deliverable report D6.6 of E-HUB project. 101 pages.

Koponen, Pekka; Pykälä, Marja-Leena; Sipilä, Kari. 2008. Needs and availability of AMR data in energy performance evaluation of buildings (reported in Finnish, Mittaustietojen tarpeet ja saatavuus rakennuskannan automaattisten energia-analyysien näkökulmasta). Espoo, VTT. 62 s. + liitt. 3 s. VTT Tiedotteita - Research Notes; 2438  
ISBN 78-951-38-7216-8 <http://www.vtt.fi/inf/pdf/tiedotteet/2008/T2438.pdf>

Lahdenperä, Pertti & Rintala, Kai. Thoughts on DBFO. A study of UK accommodation service procurement for the benefit of Finnish practice (in Finnish). Espoo 2003. VTT Research Notes 2192. 52 s. + appendix 2 s.

Lahdenperä, Pertti, Nykänen, Veijo & Rintala, Kai. Design-Build-Operate. Alternative modes of operation for accommodation services (in Finnish). Espoo 2005. VTT Research Notes 2315. 56 s.

Lampinen, Mikko, 2011: Pientaloalueen kaukolämpöverkoston teknistaloudellinen tarkasteleminen (in Engl. Techno-economical study for district heating network in single family house area). Opinnäytetyö. Mikkelin ammattikorkeakoulu.



Motiva, 2012: Feed-in tariffs. [http://www.motiva.fi/en/energy\\_in\\_finland/key\\_policies/feed-in\\_tariffs/](http://www.motiva.fi/en/energy_in_finland/key_policies/feed-in_tariffs/)

Nystedt, Åsa; Sepponen, Mari; Teerimo, Seppo; Nummelin, Johanna; Virtanen, Mikko; Lahti, Pekka. 2010: EcoGrad - A concept for ecological city planning for St. Petersburg, Russia. VTT Tiedotteita – Research Notes 2566

Ofgem, Guidance on third party access charges for licence exempt gas and electricity distribution networks, <http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=366&refer=Networks/Policy>.

Osterwalder, A, Pigneur, Y., Tucci, C. L. Clarifying business models: origins, present, and future of the concept. AIS Article, Volume 15. 2005.

Pesola, Aki; Bröckl, Marika; Vanhanen, Juha, 2011: Älykäs kaukolämpöjärjestelmä ja sen mahdollisuudet. Loppuraportti. Gaia Consulting Oy.

Pollitt, M. Does electricity (and heat) network regulation have anything to learn from fixed line telecoms regulation?, Energy Policy, 38, 2010, 1360-1371

Pront-van Bommel, S. (2011), Smart energy grids within the framework of the Third Energy Package, European Energy and Environmental Law Review, 20(2), 32-44.

Rahunen Marjo, 2008 : Yksityisrahoitusmalli kunnan vaihtoehtoisena palvelutuotannon investointien toteutus- ja rahoitusmuotona (in engl. Private financing as alternative for implementation and financing municipal services). Master's thesis. University of Tampere, Department of Economics and Accounting, Finland

Ragwitz, M., Held, A., Resch, G., Faber, T., Haas, R., Huber, C., Morthorst, P.E., Jensen, S.G., Coenraads, R., Voogt, M., Reece, G., Konstantinaviciute, I., Heyder, B; 2007: Assessment and Optimisation of Renewable Energy Support Schemes in the European Electricity Market. Final Report. Fraunhofer ISI, Karlsruhe. [secondary source through Klessmann et al, 2011]

Rajalämpö 2005. Mäkelä, Veli-Matti; Nousiainen, Heikki; Tuunanen, Jarmo, 2005: Käytettyjä ratkaisumalleja asiakasrajapinnan siirtoon (in engl. Used solutions for client interaction) . RajaLämpö-projekti. Mikkelin Ammattikorkeakoulu.

Räsänen R., 2004: Kiinteistöpalvelusopimukset elinkaarihankkeissa. Liiketaloudelliset riskit ja niiden estäminen. (in engl. Real estate service contracts in life-cycle projects. Business risks and prevention of the risks) . Master's thesis 2004. Helsinki University of Technology. [secondary source through Heimonen et al, 2007]

Richtsnoeren opzegvergoedingen, NMa. Besluit van de Raad van Bestuur van de Nederlandse Mededingingsautoriteit nummr 102740/BT 827, Stcrt. 2008, nr. 13.

Rintala, Kai. 2004. The economic efficiency of accommodation service PFI projects. Espoo, VTT. 286 p. + app. 186 p. VTT Publications; 555.

SEC(2008) 57: The support of electricity from renewable energy sources. Commission Staff Working Document – accompanying document to the proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources. Brussels, 23.1.2008. Available: [http://ec.europa.eu/energy/climate\\_actions/doc/2008\\_res\\_working\\_document\\_en.pdf](http://ec.europa.eu/energy/climate_actions/doc/2008_res_working_document_en.pdf)

Six D., Fritz W, and Kessel, K, 2010: Potential Barriers and Solutions for Active Demand: a Qualitative Analysis.

Szatow, Anthony; Quezada, George, and Lilley, Bill, 2012: New light on an old problem: Reflections on barriers and enablers of distributed energy. *Energy Policy* 43 (2012) 1-5.

Syvänen, Topi ja Mikkonen, Katja, 2011: Saisiko olla lähienergiapalveluja? Kyselytutkimus: Omakotitalojen, taloyhtiöiden ja vapaa-ajan asunnon asukkaiden tarpeet energiaratkaisuja ja uusia lähienergiapalveluja kohtaan. (in engl. Would you like to have local energy?) Taloustutkimus Oy. Sitran selvityksiä 60.

Tieva, A. & Junnonen, J-M. (2009). Proactive contracting in Finnish PPP projects. *International Journal of Strategic Property Management*, Vol 13, No. 3/2009, pp. 219-228

Vantaan energia, 2011: Kaukolämmön lämmönjakokeskus (in engl. District heating substation).

Zhang, X.Q., Kumaraswamy, M.M. 2001. Procurement protocols for public-private partnered projects. *Journal of construction engineering and management* 127 (5) Sep-Oct 2001. pp. 351-358.

Zhang, Zueqing, 2005: Critical Success Factors for Public-Private Partnerships in Infrastructure development. *Journal of Construction Engineering and Management* pages 3-14.

## Annex A      A summary of acronyms and terminology

BLT	= Build Lease Transfer
BOO	= Build Own Operate
BOOT	= Build Own Operate Transfer
BOT	= Build Operate Transfer
BRP	= Balancing Responsible Party
BRT	= Build Rent transfer
CCHP	= Combined Cool, Heat and Power
CHP	= Combined Heat and Power
D&B	= Design and Build
DBFO	= Design Build Finance Operate
DG	= Distributed Generation
DSM	= Demand Side Management
DSO	= Distribution System Operator
ESCO	= Energy Service Company
H&C	= Heating & Cooling
ICT	= Information and Communication Technology
NPV	= Net Present Value
PFI	= Private Finance Initiative
PPP	= Public Private Partnership
RES	= Renewable Energy Source
T&D	= Transmission & Distribution
TSO	= Transmission System Operator

## Annex B Fact sheet for collection of information on E-HUB related cases studies

eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. to D 1.1	List the stakeholders acc. to the stakeholder mind map in the instruction paper	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. to the D1.1 "First-level (conceptual) system definition of the E-Hub", e.g. Local heating network, electricity driven HP, smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project [name]				
Location				
Developer [private, public, PPP joint venture]				
Status [development, construction, operation]				
Drivers	Part II: Business and value models for selected projects only			
	Describe the value network acc. to instruction, or a simple flow chart or detailed network model produced by e3VALUE	Describe the applied business model acc. to e.g. Osterwalder's method.	Describe here the principal financial model of the project: i) public, private, or PPP financing; ii) source of financing: private project funding, institutional financier (e.g. EIB); iii) pay-back scheme: on-bill financing (OBF), energy savings contracting (ESCO), etc	Describe here operational model, e.g. who is responsible for operating of the energy system. List what kind of ICT solutions are applied.
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
Source of data [project report, web site,...]	Node company:			

### Project information

- Project name: Give the name of the project
- Location: Give the address of the project / urban or rural area
- Developer: Give the name of the developer
- Drivers: Motivation of the project, e.g. a pilot, demonstration etc,
- Source of data: Give the major reports, web sites etc
- 

### Part I: Identified national E-HUB projects

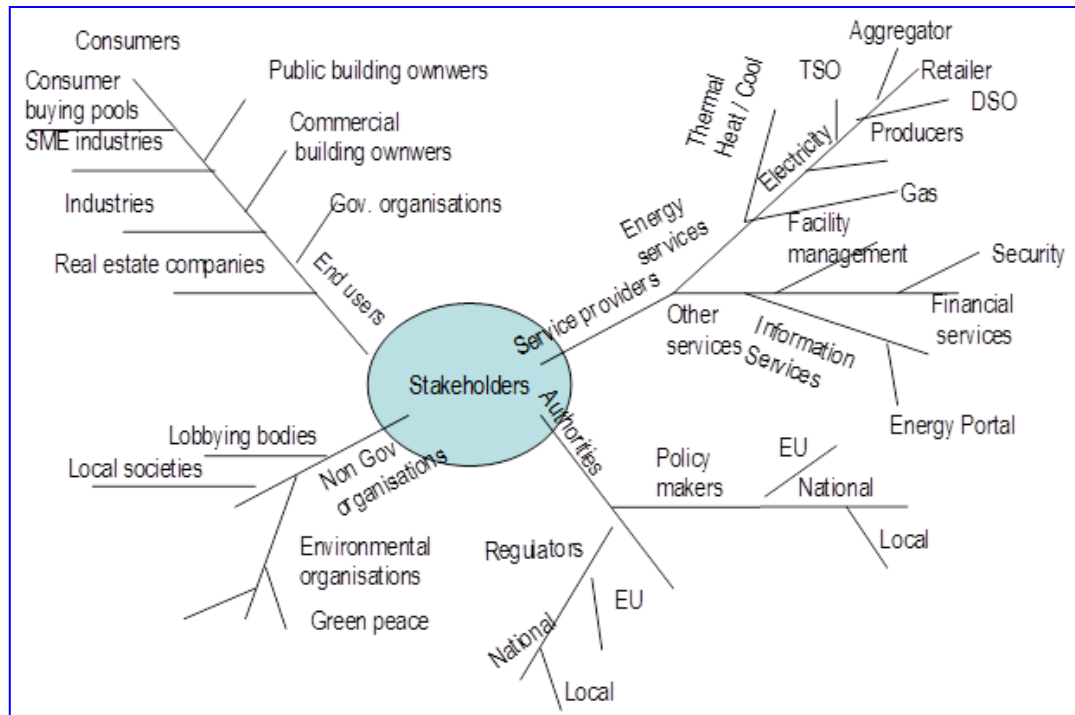
#### Block #1: District / admin model applied

Description of the district model (city, community, village,...) of the project, decision making regarding e.g. the selection of the energy system, who has been the promoter of the project. Also the size (e.g. the floor area served) and if a single building, a group of buildings or a district.

#### Block #2: Stakeholders involved

Project stakeholders are those entities within or outside an organization that are actively involved in the project, or whose interests may be affected as a result of project execution or project completion, e.g.: sponsor a project, or have an interest or a gain upon a successful completion of a project; may have a positive or negative influence in the project completion.

Potential stakeholders involved in the project are given in the mid map picture below.



### Block #3: Service scope

*Scope is an arbitrary detail that is used to define the limits of a Business Service. Scope items can be of any type or granularity and are used to define what the Business Service can provide (In Scope) and what it cannot provide (Out of Scope).*

For the E-HUB projects, break down of the services provided to the end user, e.g. heating, cooling, electricity, gas, water,... facility management, information, other services like financing, ESCO,... will be given.

### Block #4: Technology scope

Description of the solution and technologies applied to the energy system:

- Energy production
- Energy transmission
- Energy distribution
- End user premises
- 

For instance, there is a local low Ex heating network, heat is produced from waste water by electricity driven heat pump), smart energy metering,...etc. Give also the capacity of the system (e.g. heating energy supplied XX GWh/a), and costs of the project if available.

## Part II: Business and value models for selected EU projects only

### Block #5: Value network

*A value network is a business analysis perspective that describes people and technical resources within and between businesses. The nodes are connected by interactions that represent tangible and intangible deliverables. These deliverables take the form of knowledge or other intangibles and/or financial value. The value network is often driven by so called node company.*

Description of the value network applied in the project is given here: how the business is organized, i.e. the value network hierarchy, e.g. through contractual situation: who has made the service contract with

the end user (node company), who are the suppliers to the node company and who are their suppliers etc, are there end user groups formed (e.g. consumer buying pools, producers' aggregator, DSM pools / load management groups).

Also a simple flow diagram can be used / added : the actors involved and services vs fees between them. A more detailed network model can be produced by e.g. the e3VALUE tool.

#### **Block #6: Business model applied**

Description of the business model of the node company.

*Business model is a description of the operations of a business including the components of the business, the functions of the business, and the revenues and expenses that the business generates.*

*Osterwalder has introduced so called business model canvas having nine elements grouped into four blocks to be addressed:*

##### Business Infrastructure

- Key Activities: The activities necessary to execute a company's business model.
- Key Resources: The resources necessary to create value for the customer.
- Partner Network: The business alliances which complement other aspects of the business model.

Offering / Value Proposition: The products and services a business offers. See above "Block #3 Service scope". Quoting Osterwalder, a value proposition "is an overall view of services that together represent value for a specific customer segment.

##### Customers

- Customer Segments: The target audience for a business' services.
- Channels: The means by which a company delivers services to customers.
- Customer Relationship: The links a company establishes between itself and its different customer segments. The process of managing customer relationships is referred to as customer relationship management.

##### Finances

- Cost Structure: The monetary consequences of the means employed in the business model.
- Revenue streams (income): The way a company makes money through a variety of revenue flows.

#### **Block #7: Financial model applied**

Description of the principal financial model of the project: i) public, private, or PPP financing ; ii) source of financing : private project funding , institutional financier( e.g. EIB); iii) pay-back scheme: on-bill financing (OBF), energy savings contracting (ESCO ), etc

Breakdown of who has invested to / owns :

- Energy infra (production, transmission/ distribution, end-use devices)
- ICT solutions

Osterwalder business model canvas produced by tools available

(<http://www.businessmodelgeneration.com/>)

#### **Block #8: Operational model / business solution**

Description of the operational model, e.g, who is responsible for operating of the energy system. Listing of ICT solutions are applied, e.g.

- Interactive Smart meters
- End user info system
- Energy system operating system
- Billing and invoicing

## Annex C Description of cases in partner countries

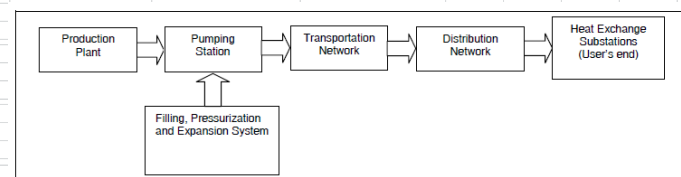
eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1 ...	List the stakeholders acc. To the picture XXX of document zzz	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. To the WP 7, e.g. Local heating network, electricity driven HP , smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project <b>Large district Heating System (Province of Turin)</b>	<b>Owner of the system:</b> IREN S.p.A. (multi-utility public-private held. Main public shareholders: City of Turin/City of Genoa. Main private shareholders: Intesa Sanpaolo Bank / Fondazione CRT, a banking foundation). <b>Management and heating distribution</b> operated by AES Torino S.p.A (51% IREN, 49% ITALGAS, the Italian natural gas distribution company). <b>Sale to final customer</b> operated by IREN Mercato S.p.A. (100% owned by IREN S.p.A.).	<b>1.</b> City of Turin, Piedmont Region, Turin Provincial Administration <b>2.</b> IREN S.p.A. (MultiUtility company active in electrical energy production, district energy - 1st Italian operator, gas, water, waste treatment) <b>3.</b> AES Torino S.p.A (utility company active in natural gas and heating distribution / O&M) <b>4.</b> IREN Mercato S.p.A. (gas&energy commercialization company) <b>5.</b> Citizens (final customers)	Heating + Energy + Gas	The largest Italian district heating system providing 54.000.000 m3 heated volume and serving 540.000 inhabitants. It includes: - 4 CHP plants (Moncalieri, Le vallette, Mirafiori Nord, Torino Nord) - 400 km of double pipelines, divided in transportation and distribution network - 3.650 district heating substations Starting from 2016 an incinerator (Gerardo) will be connected to the district heating: surplus of heat will be channeled in the network.
Location <b>Turin, Italy</b>				
Developer <b>MultiUtility company</b>				
Status <b>Operation</b>				
Drivers - <b>Active involvement of Municipality, Piedmont Region and Torino's Provincial Administration since the designing phase of the project.</b> - <b>Ownership / management / commercialization are split among three different companies</b>				
Part II: Business and value models for selected projects only				
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1).	Describe the district model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
Source of data [project report, web site,...]	Node company: IREN S.p.A.	IREN Mercato is the only operator authorized to sell district heating to final customers (it operates in a condition of monopoly). <b>Final customer:</b> pays to IREN Mercato heating bill and installation costs.	The development of the district heating project was financed through IREN Group own funds + European financing from BEI + national Government financing.	IREN S.p.A.: designed and built the district heating network AES Torino S.p.A.: is in charge of operation & management of district heating network. IREN Mercato S.p.A: is in charge of selling heating to final customers.
http://www.districtenergyaward.org/download/awards2011/Expansion_Italy_Torino_2011.pdf				

Existing District Heating System in Turin

```
graph LR;
    A[Production Plant] --> B[Pumping Station];
    B --> C[Transportation Network];
    C --> D[Distribution Network];
    D --> E[Heat Exchange Substations (User's end)];
    F[Filling, Pressurization and Expansion System] <--> B;
```





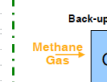


	2010	2012
Electrical energy (CHP)	3.900 GWh	5.900 GWh
Thermal Energy in the network	1.700 GWh (90%CHP)	2.200 GWh (96% CHP)
Thermal energy to the users	1.500 GWh	2.000 GWh
Primary Energy used	8.000 GWh	11.700 GWh

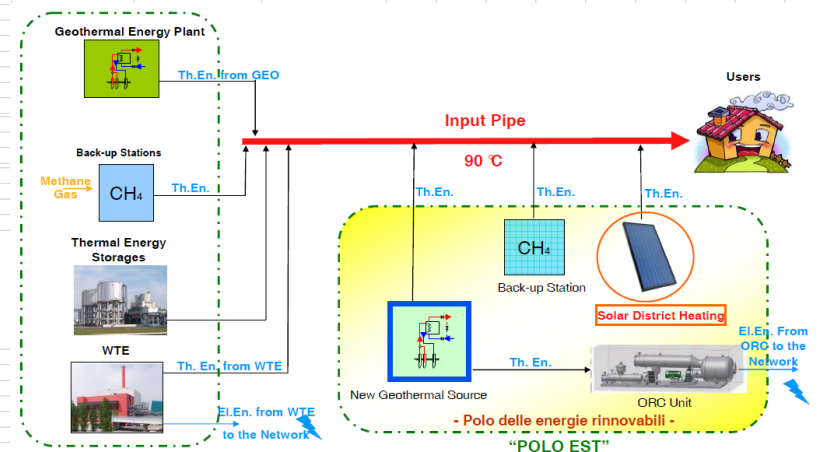
Existing District Heating System in Turin



	2010	2012
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eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1 ...	List the stakeholders acc. To the picture xxx of document zzz	Lists down the service provided: heating, cooling, electricity/gas, facility management, others	Describe the energy system acc. To the WP 2, e.g. Local heating network, electricity driven HP, smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project "Polo Energie Rinnovabili" - Integrated Energy System	The owner of the Integrated Energy System is HERA S.p.A. (currently 58.92% held by public bodies and 41.08% held by private investors). HERA S.p.A. developed the Integrated Energy System and sells heating and energy to final customers. In order to increase active involvement of customers, HERA organizes frequent meetings with local communities, guided visits to its plants and cooperation with local schools.	1. City of Ferrara 2. HERA S.p.A. (MultiUtility company providing energy and environment related services) 3. Consorzio Ferrara Ricerche (no profit public-private research centre) 4. Citizens (final customers)	Heating + Cooling (through absorption chillers) + Energy + Maintenance/repairs of distribution lines and heat substations	Integrated Energy System involving: - Geothermal plant (underground source of hot water) - Waste - To - Energy plant - Back-up thermal stations, supplied with methane gas, satisfying the demand during consumption-peaks. - Solar Thermal Plant + ORC system under development (first example in Italy of Solar Thermal applied to District Heating). The system was able to produce about 179 GWh thermal energy in 2011, the 83% of which comes from renewable energy or
Location Ferrara, Italy				
Developer MultiUtility company				
Status Operation / Development (extension of the existing district heating network by adding a Solar Thermal plant).				
Drivers				
- One of the first examples of integrated energy district in Italy, combining different RES sources				
- Ownership/management/commercialization are in the hands of the same subject				
	Part II: Business and value models for selected projects only			
	Describe the value network acc. To: e3Value	Describe the applied model acc. To the Osterwalder method: 1)...	Describe the district model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
Source of data [project report, web site,...]	Node company: HERA S.p.A.	Public-private utility: sells heating + maintenance to final customers. Final customer: pays to HERA an heating bill (consumed heat is established through an heat meter) + an installation cost (it depends on length of pipes needed to connect the house to district heating lines and on power allocation. It must be established by a technician). Heating tariffs are established starting from methane gas price and include costs related to maintenance and heat meter's lease. Special terms are available for low income customers ("Social Bonus").	UNKNOWN	HERA S.p.A. is responsible for the whole design and construction process: 1) construction and management of energy/heat cogeneration plants 2) construction and management of thermal power stations and air conditioning systems 3) production, transport and sale of heat for industrial and domestic use
<a href="http://www.districtenergyaward.org/download/awards2011/Modernization_Italy_Ferrara_2011.pdf">http://www.districtenergyaward.org/download/awards2011/Modernization_Italy_Ferrara_2011.pdf</a>				
<a href="http://www.gruppohera.it/clienti/casa/casa_lista_servizi/casa_teleriscaldamento/32152.html">http://www.gruppohera.it/clienti/casa/casa_lista_servizi/casa_teleriscaldamento/32152.html</a>				

	Total Flow Rate	400 m³/h
	Temperature of Geothermal Fluid	105 - 105 °C
	Temperature of the fluid in district heating network:	
	- input	90° - 95°C
	- output (on the back way)	60° - 65°C
	Thermal Nominal Power	14 MW
	Thermal Energy Produced	Approx. 75.000 MWh/year
	Authorized Capacity of waste disposal	130.000 ton
	Electric Power to the system	13 MW
	Electric Energy to the system	87.000 MWh
	Max. Thermal Power for heating network	29 MW
	Total Thermal Energy produced for the district heating system	approx 80.000 MWh/year
	Back-up Station Power	84 MW
	Energy storages	Approx 1.000 m³ each







eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1 ...	List the stakeholders acc. To the picture XXX of document zzz	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. To the WP ?, e.g. Local heating network, eletrcity driven HP , smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project <b>District heating plant in Busto Arsizio</b>	The City of Busto Arsizio entrusted AGESP Energia S.r.l., the energy public utility, to build and maintain a district heating system covering the Busto Arsizio territory. The land is owned by the city.	1. City of Busto Arsizio 2. AGESP Energia S.r.l. (100% owned by City of Busto Arsizio) 3. Citizens (final customers)	Heating + Ordinary/Extraordinary maintenance and repair	Integrated district heating network: - a cogeneration plant (2 CHP units + 3 gas fired boilers) with an electric power of 5.2 MWe and a heat power of 42MWt. - 3 distribution lines.
Location <b>Busto Arsizio, Italy</b>				
Developer <b>Public utility</b>				
Status <b>Development</b>				
Drivers - Realisation of a district heating system in a midsize Italian city (population < 100.000) - Construction/management/commercialization operated by a Utility 100% owned by the Municipality which promoted the project.				
	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)..	Describe the distrcit model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
	Node company: AGESP Energia S.r.l.	<u>Public utility:</u> sells heating + maintenance to final customers. <u>Final customer:</u> pays to AGESP Energia an heating bill (consumed heat is established through an heat meter) + the cost of connecting its dwelling to the district heating lines (this payment can be deferred by yearly installments). Special discounts are offered to customers available to connect their dwelling to the district heating lines when they are installed.	Approx. investment: 80 Million Euro	AGESP Energia S.r.l. is responsible for the whole construction and development process: 1) building the co-generation plant 2) installing the feed and return lines 3) installing the heat substation in dwellings/houses 4) connecting the dwelling with the district heating lines
Source of data [project report, web site,...]				
http://agespenergia.agesp.it/pdf/teleriscaldamentovolantino.pdf				

eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1 ...	List the stakeholders acc. To the picture XXX of document zzz	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energysystem acc. To the WP 7, e.g. Local heating network, electricity driven HP , smart metering....
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project <b>District heating network in small villages</b>	The local municipality started with the intention to build up a micro network for the heat supply of public buildings in the center of the village. During the following discussions the plan was expanded to build up a network for the whole community incl. 2 villages (Laas and Eysr). To manage the project a cooperative society composed of Municipality + all End users + farmers was set up.	1. Village of Laas, Village of Eysr 2. Cooperative society (municipality + all end-users + some farmers) 3. Danfoss (private global company providing heating and refrigeration systems)	Heating + Ordinary/Extraordinary maintenance and repair	<b>District heating network:</b> 13 MW (heat capacity) 10 MW (sold heat) Km of pipe: 23 km Number of supplied objects: 540 Heat source: biomass and for peak load biodiesel Oil Boiler (biodiesel): 5,5 MW Biomass Boiler (Schmid): 6,2 MW
Location <b>South Tirol, Italy</b>				
Developer <b>Private company</b>				
Status <b>Operation</b>				
Drivers - Realisation of a biomass distict heating system serving two small villages Foundation of a cooperative society (municipality, all end-users, some farmers) to implement and manage the project	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)...	Describe the district model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
	Node company: Danfoss	<b>Municipalities involved:</b> promoted the project and are associate to the cooperative society <b>Danfoss:</b> acted as consultant in the design phase and developed the project. <b>Cooperative society:</b> commercializes heating to end users	Approx. investment (complete network incl. boiler house, network etc.): 13 Million Euro	Danfoss was responsible for project design and development, including trainings for local plumbers/electricians; analyse of current state of every boiler house; approval of calculated heating capacity; optimization concept for every house; implementation of substations through local plumbers.  An Energy Control System (DECS) was implemented.
Source of data [project report, web site,...]				
<a href="http://heating.danfoss.com/PCMFFiles/1/master/other_files/library/case_stories_references/Case_story_biomass_Italy.pdf">http://heating.danfoss.com/PCMFFiles/1/master/other_files/library/case_stories_references/Case_story_biomass_Italy.pdf</a>				

eHUB	Part I: Identified national eHUB projects			
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	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project <b>Small biomass district heating network serving public buildings</b>	<u>Ownership of biomass boilers:</u> Municipalities of Arquata Scrivia, Serravalle Scrivia, Vignole Borbera <u>Management</u> operated by BEA S.r.l., a company held by public (Borbera Mountain Community, Municipality of Arquata Scrivia, Serravalle Scriva and Vignole Borbera) and private (Cooperativa Forest) partners.	1. Borbera Mountain Community (public local body responsible for forest management) 2. Municipalities of Arquata Scrivia, Serravalle Scrivia, Vignole Borbera 3. Piedmont Region (regional authority) 4. BEA S.r.l. (public-private company) 5. Cooperativa Forest (farmers cooperative)	Heating	Small district heating system of 550 m of lenght connected to 1 MW biomass boiler + 2 autonomous biomass boilers. Biomass is derived: 60% from local forestry; 8% from parks and gardens maintenance; 32% from sawmills residues.
Location <b>Borbera Valley (rural area in South East of Piedmont), Italy</b>				
Developer <b>public-private company + farmers cooperative</b>				
Status <b>Operation</b>				
Drivers - Long term partnership between Municipalities and a farmers cooperative - Separation between the subject owning the boilers and the subject managing them - End users are buildings owned by Local Authorities.				
	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)..	Describe the distrct model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
	Node company: BEA S.r.l.	BEA signs annual contracts with its private partner Cooperativa Forest for maintenance of boilers and fuel supply. The service is paid per kWh provided. Cooperativa Forest has an agreement with biomass suppliers. The payment is per volume of biomass provided. Final customer are the public buildings owned by the Municipalities involved in the project.	The installation of biomass boilers was financed up to 100% through public funding by Piedmont Region. Grants were assigned through a public tender, on a competitive basis.	BEA S.r.l., through Cooperativa Forest, manages the whole chain of fuel supply and energy production: 1. securing wood chip supply 2. biomass transport to the boilers 3. ordinary maintenance of boilers 4. fuel supply to public buildings
Source of data [project report, web site,...]				
http://www.forestprogramme.com/files/2011/11/Case_study_BEASrl-Val-Borbera-Energia-e-Ambiente.pdf				

eHUB	Part I: Identified national eHUB projects				
WP #6 : Task 6.1.1					
eHUB project fact sheet	Describe the district model acc. To the WP 1 ...	List the stakeholders acc. To the picture XXX of document zzz	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. To the WP ?, e.g. Local heating network, electricity driven HP , smart metering,....	
	District / admin model applied	Stakeholders involved	Service scope	Technology scope	
Project <b>Eco-building for social housing in Sanpolino district</b>	The developer of the project is CoopCasa, a cooperative society of citizens including more than 4000 associates. Coop Casa usually builds apartments to be assigned to associates against payment of a monthly rent. CasaCoop also provides the Municipality of Brescia with services of buildings maintenance.	1. City of Brescia 2. Lombardia Region 3. CoopCasa Brescia (cooperative society) 4. Citizens (final customers)	Construction and Sale of dwellings / buildings maintenance	Realisation of a 29 units condominium complex with low energy profile in the Sanpolino district (City of Brescia). Technical features: - mechanical ventilation system with heat recovery (efficiency about 90%) - 65% hot water for sanitary use provided by solar thermal plant - solar-PV plant to provide energy for common spaces - windows with low transmittance - exterior Insulation and Finishing System	
Location <b>Brescia, Italy</b>					
Developer <b>Cooperative society</b>					
Status <b>Construction</b>					
Drivers - <b>Social housing</b> - <b>Public funding</b>					
	Part II: Business and value models for selected projects only				
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)...	Describe the district model acc. To the WP 1		
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions	
	Node company: CoopCasa	City of Brescia: issued a public tender for the construction of a low energy consumption condominium complex to be used for social housing.	The realisation of the building was financed through public funding from Lombardia Region.	UNKNOWN	
Source of data [project report, web site,...]		Lombardia Region: provides financing and, in collaboration with City of Brescia, establishes criteria for assignment of the apartments to low income households			
http://www.coopcasa.coop/interventi/sanpolino-comparto-18.html		Cooperative society of citizens: was awarded with the tender for the construction of the condominium.			

eHUB	Part I: Identified national eHUB projects					
WP #6 : Task 6.1.1						
eHUB project fact sheet	Describe the district model acc. To the WP 1 ...	List the stakeholders acc. To the picture XXX of document zzz	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energysystem acc. To the WP 7, e.g. Local heating network, eletricity driven HP , smart metering,...		
District / admin model applied		Stakeholders involved	Service scope	Technology scope	The Eco-village in Alessandria	
Project Realisation of an eco-village	UNKNOWN	SOFTECH Total Environmental Action s.r.l.- Italy (Coordinator); Città di Alessandria- Italy; Heat & Power s.r.l.- Italy; DHV- The Netherlands; Fundacao Gomes Teixeira da Universidade do Porto- Portugal; Politecnico di Torino- Italy; Trecodome- The Netherlands; CIEPA- Italy; UNICAPI- Italy; Consorzio Edilizio Unione- Italy; Coop. Carlo LEVI- Italy; Câmara Municipal do Porto- Portugal; Câmara Municipal de Távira- Portugal; Câmara Municipal de Moura-	Construction and Sale of dwellings / buildings maintenance	Construction of an eco-village in the City of Alessandria, including: - eco-refurbishment of 299 existing social dwellings - new eco-village (101 dwgs + 50 dwgs for elderly people ) - health centre (sport, swimming, gymn) - diffuse energy retrofit programme - passive solar greenhouses - energy provided through a biomass trigeneration plant + solar thermal plants installed on new dwellings and on the health centre + PV plant		
Location Alessandria, Italy						
Developer Private company						
Status Operation						
Drivers - European Union financing through FP6-Concerto Programme - Involvement of foreign stakeholders						
Part II: Business and value models for selected projects only						
Describe the value network acc. To e3Value		Describe the applied model acc. To the Osterwalder method: 1)..	Describe the distrcit model acc. To the WP 1			
Value network (hierarchy)		Business model applied	Financial model applied	Operational model / Business solutions		
Node company:		UNKNOWN	The project was funded by the European Commission through the FP6 Concerto measure: Project Cost: 8.53 million euro Project Funding: 3.47 million euro	UNKNOWN		
Source of data [project report, web site,...]						
<a href="http://www.rigenergia.it/rg/netdownload_pup.aspx?amb=1-0-0-507-0">http://www.rigenergia.it/rg/netdownload_pup.aspx?amb=1-0-0-507-0</a>						
<a href="http://cordis.europa.eu/fetch?CALLER=FP6_PROJ&amp;ACTION=D&amp;DOC=1&amp;CAT=PROJ&amp;QUERY=012a46fedd4:549a:12b9ca3a&amp;RCN=85685">http://cordis.europa.eu/fetch?CALLER=FP6_PROJ&amp;ACTION=D&amp;DOC=1&amp;CAT=PROJ&amp;QUERY=012a46fedd4:549a:12b9ca3a&amp;RCN=85685</a>						

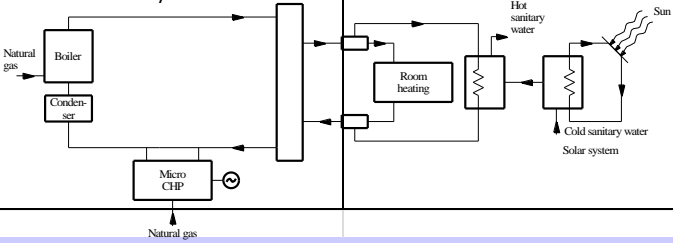
eHUB	Part I: Identified national eHUB projects			
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	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project <b>ESCO serving private industrial company</b>	8-years contract between ESCO and final customer, establishing the selling price of electrical /thermal/freezing energy and the initial investment cost for the customer. At the end of the contract, there is the possibility for the final customer of becoming onwer of the entire trigeneration system, by buying it from the ESCO.	1.Cogenpower S.p.A. (ESCO providing energy/gas/heating to industrial and institutional clients + installing and maintaining cogeneration /PV/Hydroelectric plants) 2. Baxter Engineering Ltd (private company importing and commercializing energy plants and technologies) 3. Mechanical company (final customer)	Services offered by ESCO: Installing trigeneration plant + Ordinary and extraordinary maintenance + sale of electrical/thermal/freezing energy + purchase of natural gas on behalf of the client + installing and managing software for the control of the whole energy system	- Cogeneration unit (230 kWe / 351kWt) - Refrigeration unit (245 kWf)
Location <b>Piedmont Region, Italy</b>				
Developer <b>ESCO</b>				
Status <b>Operation</b>				
Drivers <b>ESCO involvment</b>				
	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)..	Describe the distrct model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
	Node company: CogenPower S.p.A.	<u>Final customer:</u> company needing electrical/thermal/freezing energy for a new 15000 sqm building (estimated yearly energy bill of 400.000 Euro) <u>ESCO:</u> guarantees 15% savings on the client's energy bill by installing a trigeneration system and selling electrical/thermal/freezing energy at a fixed price contractually defined. <u>Technical supplier:</u> sells to ESCO the equipment to be installed at client's premises	The final customer only bears the costs related to: buying and installing boilers + refrigeration unit + purchasing electrical /thermal/freezing energy from ESCO at a favourable price. Investment cost: 140.000 Euro Yearly savings: 62.000 Euro (15.5%) Payback time: 2.26 years No costs for maintenance / No contract for purchase of natural gas (both are provided by ESCO)	A proprietary remote control software developed by the ESCO (Cogenpower Hermes) has been installed.
Source of data [project report, web site,...]	Supplier: Baxter Enegineering Ltd			
<a href="http://old.solarexpo.com/solarexpo/ita/programma/07/convegni/atti/fire/Baxter.pdf">http://old.solarexpo.com/solarexpo/ita/programma/07/convegni/atti/fire/Baxter.pdf</a>				


eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1 ...	List the stakeholders acc. To the picture XXX of document zzz	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. To the WP ?, e.g. Local heating network, eletrcricity driven HP , smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project 'Biella Retrofitting One' (ESCO serving public entity)	The refurbished apartments (socially rented houses) are owned by ATC Biella, a public entity managing social housing. The developer is ESCO Italia S.p.A a private Energy Services Company.	1. ATC Biella (Agency for Territorial House) 2. Federcasa (national social housing association) 3. ESCO Italia S.p.A. (private ESCO) 3. ENEA (Public research centre) 4. Citizens (final customers)	Energy + Heating management	Energy refurbishment of 161 apartments built in the 70s, including: No. windows replaced = 90 Isolation porches and basements = 3985 Loft insulation (m) = 3972 Central heat processed in substation = 6 New cogenerators 60 Kw = 2 Radiators with thermostat with accounting for heat = 934
Location Biella, Italy				
Developer ESCO				
Status Operation				
Drivers				
Third Party Financing Social Housing	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1) ..	Describe the distrct model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
	Node company: ESCO Italia S.p.A	UNKNOWN	The total investment for energy refurbishment is of 4 mln Euro: 88% of costs were borne by the ESCO and 12 % by ATC (own resources). ESCO applied a third party financing (TPF) scheme. According to TPF plan, 1. ESCO bear the costs of the project, 2. ESCO subscribes a 12-years contract with ATC, according to which ESCO provides ATC with energy management services and ATC transfers to ESCO a percentage of the economic value of energy savings. 3. At the end of the 12-years contract the cogeneration system will be ATC property.	UNKNOWN
Source of data [project report, web site,..]				
http://www.tackobst.eu/publications-1/all-in-one/copy_of_deliverables-wp6-d19-d20-d21-d22-d23-d24/3-e-newsletters-d19/newsletter%203.pdf				



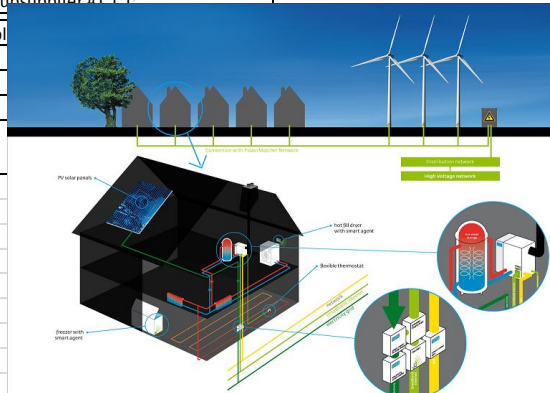





Project <b>Linear (Local Intelligent Networks and Energy Active Regions)</b>	Existing residential area in Flanders The residential field test of the Linear project aims at testing and evaluating Active Demand (AD) concepts on a representative scale and in a realistic setting.	Residential consumers Distribution system operator Retailer Balancing responsible party producers Aggregator ICT provider Telecom operators Manufacturers (household appliances) Flemish regulator / storage / distributed generation Research institutes Flemish government	Active demand through real time control and/or dynamic pricing Within Linear, "Active demand" stands for the participation of residential consumers in the provision of services to different power system participants in the form of an injection/offtake decrease/increase.	It involves all types of flexible energy resources installed at consumers premises: electrical appliances, distributed generation and thermal and electrical storage systems.
Location <b>Flanders, Belgium</b>				
Developer <b>R&amp;D project supported by the Flemish Government</b>				
Status <b>Ongoing - demonstration in 2011-2014 (residential pilot project)</b>				
Drivers <b>The project Linear is a first crucial step in the transition towards Smart Grids. The project focuses on the realization of a technological and implementation breakthrough by innovative technological research and a demonstration in an existing typical Belgian residential area.</b>				
Part II: Business and value models for selected projects only				
	Describe the value network acc. to instruction, or a insert a simple flow chart or detailed network model produced by e3VALUE	Describe the applied business model acc. to e.g. Osterwalder's method.	Describe here the principal financial model of the project: i) public, private, or PPP financing ; ii) source of financing : private project funding , institutional financier( e.g. EIB); iii) pay-back scheme: on-bill financing (OBF), energy savings contracting (ESCO ), etc	Describe here operational model, e.g, who is responsible for operating of the energy system. List what kind of ICT solutions are applied.
	<b>Value network (hierarchy)</b>	<b>Business model applied</b>	<b>Financial model applied</b>	<b>Operational model / Business solutions</b>
	Node company:	Following business cases will be tested (in brackets you can find the party who is interested in this case): • Portfolio management (retailer) • Wind balancing (BRP) • LV transformer load (DSO) • LV line voltage profile (DSO)		
Source of data <a href="http://www.linear-smartgrid.be/?q=en">http://www.linear-smartgrid.be/?q=en</a>				

eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1		List the stakeholders acc. to the stakeholder mind map in the instruction paper	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. to the D1.1 "First-level (conceptual) system definition of the E-Hub", e.g. Local heating network, eletricity driven HP , smart metering,...
eHUB project fact sheet	Describe the district model acc. to D 1.1			
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project <b>ANRE-Demonstration project µCHP in a social housing project</b>	A new social housing project with in total 19 social low-energy dwellings built by the social housing company Zonnige Kempen.	Social housing company Zonnige Kempen Residential consumers living in the social dwellings Retailer gas Retailer electricity 	Electricity Heating Domestic hot water	A µCHP was installed with an electric power of 5.5 kW and a thermal power of 12.5 kW, integrated in a building block with 12 houses. The installation was integrated in a heating system existing of a condensing boiler and a solar collector. The produced electricity is injected into the public grid. The produced heat is used for room heating and for domestic hot water production (see figure).
Location <b>Herenthout-Kempen-Flanders</b>				
Developer <b>Social housing company Zonnige Kempen</b>				
Status <b>Operational</b>				
Drivers <b>Demonstration project</b> <b>Micro CHP is an interesting alternative for reducing the energy consumption and the CO2-emissions in social housing projects.</b>	Part II: Business and value models for selected projects only			
	Describe the value network acc. to instruction, or a insert a simple flow chart or detailed network model produced by e3VALUE	Describe the applied businees model acc. to e.g. Osterwalder's method.	Describe here the principal financial model of the project: i) public, private, or PPP financing ; ii) source of financing : private project funding , institutional financier( e.g. EIB); iii) pay-back scheme: on-bill financing (OBF), energy savings contracting (ESCO ), etc	Describe here operational model, e.g. who is responsible for operating of the energy system. List what kind of ICT solutions are applied.
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
	Node company:	The produced electricity is injected into the grid. Direct supply to the dwellings wasn't possible. Zonnige Kempen thus only receives the tariff for injection into the grid for the produced electricity and the residential consumers buy electricity from retailer of own choice. Gas consumption (CHP and condensing boiler)	The investment is done by Zonnige Kempen. The project is partially financed by the Flemish Government.	
Source of data <b>Internal report</b> <b>Conference paper <a href="http://www.wseas.us/e-library/conferences/2006lisbon/papers/517-305.pdf">http://www.wseas.us/e-library/conferences/2006lisbon/papers/517-305.pdf</a></b>				

eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1	List the stakeholders acc. To the picture XXX	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. To the WP ?, e.g. Local heating network, electricity driven HP, smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project [name]: <b>Amsterdam Smart City</b>	<p>The project has been initiated by Liander and the Amsterdam Innovation Motor. Since 2009, many projects have been started scattered in the city of Amsterdam, focusing on Working, Living, Mobility and Public Space. Examples: Municipal Buildings; Smart Schools; Zuidas Solar; Ship to Grid or Smart Challenge.</p>	<p>Liander (initiator); Amsetrdam Innovation Motor; various stakeholders in projects. Supported by the European Commission (European Fund for Regional Development)</p>	<p>Various, depending on the given project.</p>	<p>Various, depending on the given project. Examples: smart meters (project Geuzenveld), energy monitoring system combined with energy saving measures in a monumental building (project De Balie); Fuel Cell Technology; electricity management system for households (project Energy Management Haarlem); Smart Plugs, energy saving street lighting, electric vehicles for collection of waste (project Climate Street)</p>
Location: <b>Amsterdam; the Netherlands</b>				
Developer [private, public, PPP joint venture]: <b>PPP (collaboration of inhabitants, government and business)</b>				
Status [development, construction, operation]: <b>Operation and development of new proejects</b>				
Drivers: <b>To illustrate how energy can be saved now and in the future with smart solutions. Implementation of innovative technologies together with stimulation of behavioural change of inhabitants. All initiatives should be economically sustainable investments and their benefits are tested in local small-scale projects, paving the way to the upscale. The goal is decrease of CO2-emissions in Amsterdam.</b>				
	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)...	Describe the district model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	
	Node company:			
Source of data [project report, web site,...]: <a href="http://www.amsterdamsmartcity.nl">http://www.amsterdamsmartcity.nl</a>	Supplier #1:			
	Subsupplier #1.1:			
	Subsubsupplier #1.1.1:			
	Supplier #2:			
	etc			

eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1	List the stakeholders acc. To the picture XXX	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energysystem acc. To the WP ?, e.g. Local heating network, eletricity driven HP , smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project [name]: <b>Smart Energy Collective</b>	Joint activity of 20 companies. Test locations will be spread over the whole country. The intention is to realize in total 5.000 smart grid connections in about 10 locations. Starting in 2010, in the beginning of 2012, the demonstration phase should be started.	ABB, Alliander, APX-ENDEX, DELTA, Draka, Eneco, Enexis, Essent, GasTerra, Gasunie, GEN Nederland, Heijmans, HUMIQ, IBM, Imtech, Itron, KEMA, KPN, Logica, Miele, Nedap, NXP, Philips, Priva, Rabobank, Siemens, Smart Dutch, Stedin, TenneT en Unica Installatiegroep. Open for other parties.	Smart metering; matching of energy demand and supply;	Smart grids; smart meters; further still unknown
Location: <b>Spread over the whole Netherlands</b>				
Developer [private, public, PPP joint venture]: <b>Private</b>				
Status [development, construction, operation]: <b>Development</b>				
Drivers: <b>Large-scale demonstration of smart grids. Speeding up of energy transition and enable the Netherlands to become an international front runner. Development and testing of integral smart energy services and technologies leading by upscale to positive business cases. Development of robust market for smart energy services.</b>	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)...	Describe the district model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	
	Node company:			
	Supplier #1:			
	Subsupplier #1.1:			
	Subsupplier #1.1.1:			
	Supplier #2:			
	etc			
Source of data [project report, web site,...]: <b>http://smartenergycollective.com</b>				

eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1	List the stakeholders acc. To the picture XXX	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. To the WP 7, e.g. Local heating network, electricity driven HP, smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project [name]: <b>PowerMatching City</b>	Hoogkerk is a residential district in the city of Groningen. 25 family houses are virtually connected to each other. In all houses, energy is generated as well as used. Demonstration started in March 2010. KEMA is the promoter and plays a major role in the realisation of the project.	European Commission (sponsor) Gasunie (sponsor) Groningen municipality (sponsor) Energieconvenant Groningen (sponsor) ECN (partner) Essent (partner) KEMA (partner) HUMIQ (partner)	electricity; domestic hot water heating; electricity demand and supply matching	Solar modules on roofs; house based heat pumps; PowerMatcher technology; Smart metering; Wind turbines; Micro CHP; Electricity storage; Electric transport; domestic electric devices with smart agents
Location: <b>Hoogkerk (Groningen)</b>				
Developer [private, public, PPP joint venture]: <b>PPP</b>				
Status [development, construction, operation]: <b>Operational</b>				
Drivers: <b>PowerMatching City is a demonstration project showing the future energy infrastructure, where supply and demand of energy are continuously tuned. Focus on local energy production.</b>				
	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)...	Describe the district model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	
Source of data [project report, web site,...]: <a href="http://www.powermatchingcity.nl">http://www.powermatchingcity.nl</a> ; <a href="http://smartgrids.nomprojects.com/nieuws">http://smartgrids.nomprojects.com/nieuws</a> ; <a href="http://www.ecn.nl/nl/nieuws/item/date/2010/03/12/powermatching-city-europese-primeur-voor-een-slim-stroomnet/">http://www.ecn.nl/nl/nieuws/item/date/2010/03/12/powermatching-city-europese-primeur-voor-een-slim-stroomnet/</a> ; <a href="http://www.buildup.eu/cases/20253">http://www.buildup.eu/cases/20253</a> ; <a href="http://smartgridsherpa.com/case-study/powermatching-city">http://smartgridsherpa.com/case-study/powermatching-city</a>	Node company: Supplier #1: Subsupplier #1.1: Subsubsupplier #1.1.1: Supplier #1.1.1.1: etc			
				

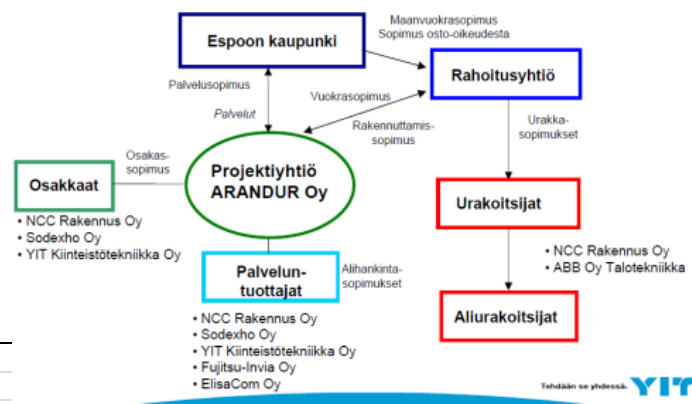
eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1	List the stakeholders acc. To the picture XXX	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energysystem acc. To the WP ?, e.g. Local heating network, eletrcity driven HP , smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project [name]: <b>Couperus Smart Grid</b>	Ypenburg is a residential area in Den Haag. The newly built apartment blocks of 288 flats and 4.500m2 of offices are connected in a Smart Grid. This is the largest proeject in the Nertherlands up till now. The project coordiantor is Vestia Nootdorp. Started in September 2011, deklivery in summer of 2013. The project will possibly get governmental subsidies from so-called "Proeftuinen" (test gardens) support programme.	Vestia Nootdorp (coordinator); Eneco; Stedin; Itho Daalderop; Provincie Zuid-Holland; TNO; IBM; Stichting Woonformatie Ypenburg (SWY)	space heating	Large amount of heat pumps; ground-based heat/cold storage
Location: <b>Ypenburg (Den Haag)</b>				
Developer [private, public, PPP joint venture]: <b>PPP</b>				
Status [development, construction, operation]: <b>Construction</b>				
Drivers: <b>Development of smart, efficitent and sustainable energy infrastructure in the built environment. Platform for development of new products and research on roll out and upscale possibilities of smart energy grids in combination with renewable energy sources.</b>				
	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)..  <b>Value network (hierarchy)</b>	Describe the distrct model acc. To the WP 1	
		<b>Business model applied</b>	<b>Financial model applied</b>	
	Node company:			
Source of data [project report, web site,...] <a href="http://www.perssupport.nl/apssite/persberichten/full/2011/09/20/Intelligent+energienet+Couperus+Smart+Grid+gepresenteerd+in+Den+Haag">http://www.perssupport.nl/apssite/persberichten/full/2011/09/20/Intelligent+energienet+Couperus+Smart+Grid+gepresenteerd+in+Den+Haag</a> ; <a href="http://projectontwikkeling.vestia.nl/PrintProject.aspx?id=216">http://projectontwikkeling.vestia.nl/PrintProject.aspx?id=216</a> ; <a href="http://www.installatie.nl/nieuws/id88-couperus-smart-grid-van-start.html">http://www.installatie.nl/nieuws/id88-couperus-smart-grid-van-start.html</a>	Supplier #1: Subsupplier #1.1: Subsubsupplier #1.1.1: Supplier #2: etc			

eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1 ...	List the stakeholders acc. To the picture XXX of document zzz	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. To the WP ?, e.g. Local heating network, eletricity driven HP , smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project <b>National Stadium</b>	The land and the stadium is owned by public, governmental body. The general management will be provided by COS (Central Sport Centre).Management services will be provided or organized by compny called NCS.  Next to the football stadium, the building includes conference center of 16000m2, offices of 8000 m2, fitness club, 4 restaurants, shops, etc.	1. City of Warsaw 2. COS (Central Sport Centre) 3. Company calles NCS 4. Consortium of construction companies: Alpine - Hydrobudowa – PBG 5.Elektrobudowa S. A. 6. Qumak-Sekom S. A. 7. "AGAT" S. A. 8. DEFOR S. A. 9. WIDOK S. J.	Heating and cooling Management services such as: Cleaning services Maintenance services ICT services Security company Catering	Heat from district heating network will be provided by the company called SPEC, in total heat will be provided to the building area of 1 million m3 (Heat demand is 15 MW).  New technologies applied which increase energy efficiency of the building are: - proper measurement systems, meters; - application of energy efficient installations which can control energy use - energy monitoring
Location <b>Warsaw, Poland</b>				
Developer <b>Public</b>				
Status <b>Under Construction (finish date: 01.2012)</b>				
Drivers				
-City of Warsaw and COS (Central Sport Centre) pays only for services they provide. -Some of the risks are transferred from the city and COS to other service providers.	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)...	Describe the district model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
	Node company: City of Warsaw, COS		Pubic financing: 100% of the finansing is coming from country national budget.	Building Automation System (BAS) - management and monitoring system of installations in building which ensures much better energy efficiency in the whole building:  automation of ventilation and air conditioning, automation of heating and cooling systems,monitoring of electrical installation, integration of different systems, etc.  Heat is prvided and distributed by SPEC company from district heating network.
Source of data [project report, web site,...]	Supplier #1: NCS			
1) http://www.stadionnarodowy.org.pl/	Supplier #2: Consortium of construction companies: Alpine - Hydrobudowa – PBG			
2) http://budownictwo.wnp.pl/podwykonawcy-wkraczaja-na-stadion narodowy,98592_1_0_0.html	Subsupplier #2.1: Elektrobudowa S. A.			
3) http://automatykab2b.pl/wywiady/3941-rozmowa-z-jackiem-lukaszewskim-prezesem-zarzadu-schneider-electric-buildings-polska	Subsupplier #2.2: Qumak-Sekom S. A.			
	Subsupplier #2.3: "AGAT" S. A.			
	Subsupplier #2.4: DEFOR S. A.			
	Subsupplier #2.5: WIDOK S. J.			

eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1 ...	List the stakeholders acc. To the picture XXX of document zzz	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. To the WP ?, e.g. Local heating network, electricity driven HP , smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project <b>Office building Schuco International Poland</b>	The land and the building is owned by private company Schuco International Poland Sp. zo.o.  The building includes office space of 1000 m² and magazine area of 5000 m².	1. Schuco International Poland Sp.zo.o 2. FORMO 3 ARCHITEKCI 3. JAKON Sp. zo.o. 4. Studio Projektowe Krzysztof Polkowski 5. Management company 6. Services companies: cleaning, ICT, security, catering,maintenance works, energy supplier (company SPEC) 7. Office employees of SCHUCO	Heating and cooling Management services such as: Cleaning services Maintenance services ICT services Security company Catering	Energy use: 80 kWh/m² energy per year Heat from district heating network. Energy saving technologies: - Double facade: energy generation and heat loss reduction. - Solar technologies: photovoltaic cells, solar panels. - Facade elements, windows, doors of low heat transfer. - Outside window blinds - Schüco TipTronic systems: more efficient ventilation and air conditioning systems. - BMS system
Location <b>Siestrzeń, near Warsaw, Poland</b>				
Developer <b>Private</b>				
Status <b>Operational since 06. 2010</b>				
Drivers New building for the company office, demonstration of company energy efficient solutions.				
	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)..	Describe the district model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
	Node company: Schuco International		Private financing: Schuco company	ICT solutions applied: BMS system Heat is provided and distributed by district heating network company. Thanks to energy efficient technologies applied in the building, the energy demand from the heating network is lower.
Source of data [project report, web site,...]	Supplier #1: JAKON Sp. zo.o.			
1)http://www.oknonet.pl/akcesoria/systemy/pvc/news,14794.html	Supplier #2: Studio Projektowe Krzysztof Polkowski			
2)http://www.schueco.com/web/pl/Specials/realizacji	Supplier #3: Management company (n.a)			
	Subsupplier #3.1: Cleaning company			
	Subsupplier #3.2: ICT company			
	Subsupplier #3.3: Catering company			
	Subsupplier #3.4: Maintenance company			
	Subsupplier #3.5: Energy supplier			



eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model according To the WP 1 ...	List the stakeholders according to the picture XXX of document zzz	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. To the WP ?, e.g. Local heating network, eletrcity driven HP , smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project [name] Koukkujärvi	<p>Privately on detached houses;</p> <p>Some rented apartments ??</p> <p>???</p>	<p>Residents, owners, constuction companies, energy companies, city of Tampere...</p> <p>Services offered in the area?</p>	<p>District heating and a part of the area: heat pumps (for groups of buildings?)</p> <p>Electricity</p> <p>Possibly also facility management for a part of the area??</p>	<p>Renewable energy production: district heating (perhaps low temperature system?); heat pumps in the northern area.</p> <p>Low energy buildings (or better)</p>
Location Tampere				
Developer [private, public, PPP joint venture] Public				
Status [developement, construction, operation] Development and construction (?)				
Drivers Eco Efficiency, energy efficiency				
<p>Description of the area: 20 detached house, a few row houses and townhouses, and a small area of apartment buildings and the center of the area.. Residential spaces and services. In total around 1000 inhabitants and workers.</p>	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)..	Describe the distrct model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	
	Node company:			
Source of data [project report, web site,...] EcoDrive-project reports	Supplier #1: Subsupplier #1.1: Subsubsupplier #1.1.1: Supplier #2: etc			

eHUB	Part I: Identified national eHUB projects			
WP #6 : Task 6.1.1				
eHUB project fact sheet	Describe the district model acc. To the WP 1 ...	List the stakeholders acc. To the picture XXX of document zzz	Lists down the service provided: heating, cooling, electricity gas, facility management, others	Describe the energy system acc. To the WP ?, e.g. Local heating network, eletrcity driven HP , smart metering,...
	District / admin model applied	Stakeholders involved	Service scope	Technology scope
Project <b>Kuninkaantie upper secondary school</b>	The land is owned by the financing company, ABB credit, which has a rental agreement with Arandur. Arandur provides the management services of the buildings within the district for the city of Espoo.	1. City of Espoo 2. Project company called Arandur (owned by: 3. YIT, 4. NCC, 5. Sodexho) 6. ABB	Facility management services, including: Catering services Cleaning services Janitor services Maintenance services ICT services	District heating network
Location <b>Espoo, Finland</b>				
Developer <b>PPP</b>				
Status <b>Operational</b>				
Drivers -City of Espoo pays only for the services provided, the payment is also linked to the quality of the services -Some of the risks are transferred from the city to the service provider				
	Part II: Business and value models for selected projects only			
	Describe the value network acc. To e3Value	Describe the applied model acc. To the Osterwalder method: 1)...	Describe the distrct model acc. To the WP 1	
	Value network (hierarchy)	Business model applied	Financial model applied	Operational model / Business solutions
	Node company: City of Espoo			
Source of data [project report, web site,...]	Supplier #1: Arandur (Management)			
1)	Subsupplier #1.1: NCC			
<a href="http://www.automaatioseura.fi/index/tiedostot/Elinkaari_RH.pdf">http://www.automaatioseura.fi/index/tiedostot/Elinkaari_RH.pdf</a>	Subsupplier #1.2: YIT			
2)	Subsupplier #1.3: Sodexho			
<a href="http://www.yit.fi/palvelut/Kuntapalvelut/toimintamallit/Hankkeet_elinkaarimallilla/Case-Elinkaarimalli">http://www.yit.fi/palvelut/Kuntapalvelut/toimintamallit/Hankkeet_elinkaarimallilla/Case-Elinkaarimalli</a>	Subsupplier #1.4: Fujitsu-Invia			
	Subsupplier #1.5: ElisaCom			
	Supplier #2: ABB Credit (Constructor/Financer)			
3) Leponiemi et al., Julkisen ja yksityisen sektorin välinen yhteistyö. Tampere, 2010.	Subsupplier #2.1: ABB			
	Subsupplier #2.2: YIT			

## Annex D Main research questions in web questionnaire

The main questions in web questionnaire are the following:

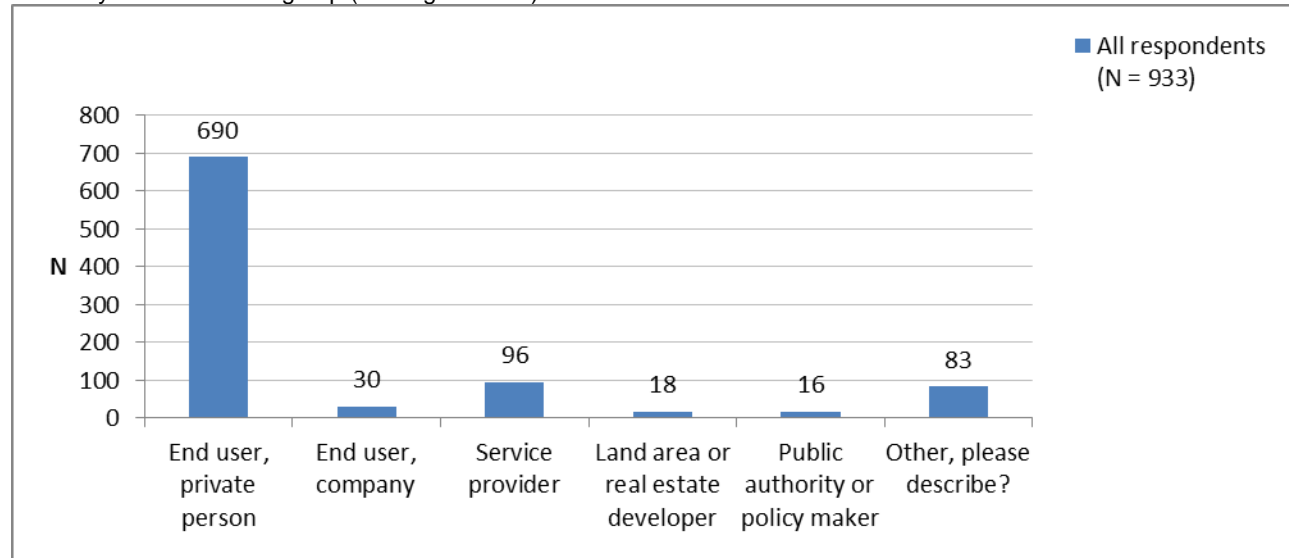
- Role in district project - stakeholder analysis
- Service or product delivered; service or product purchased; single or group of services
- Goal/aim of business; motivation to new business
- Service level offered/purchased; existing service level definitions
- Who is managing?; who should manage?; need for new operators
- Link to other stakeholders; clients & co-operations
- Administrative models in business; contractual linkages; ownership of infra & services
- Workflow in district project; decision workflow; who is doing and deciding and what and timescale of actions
- Time scale in contracts; updating of contracts
- Who's business; who is sourcing; who is making decisions
- Information needs; ICT applications; shared information;
- Risk management methods
- Financing related questions;
- Sourcing models; who is investing
- Legislative aspects; barriers
- Incentives
- Decision criteria; KPI's in decision phase
- Design criteria; KPI's in design phase
- RES – system related questions
- What kind of systems?

The main groups of questions:

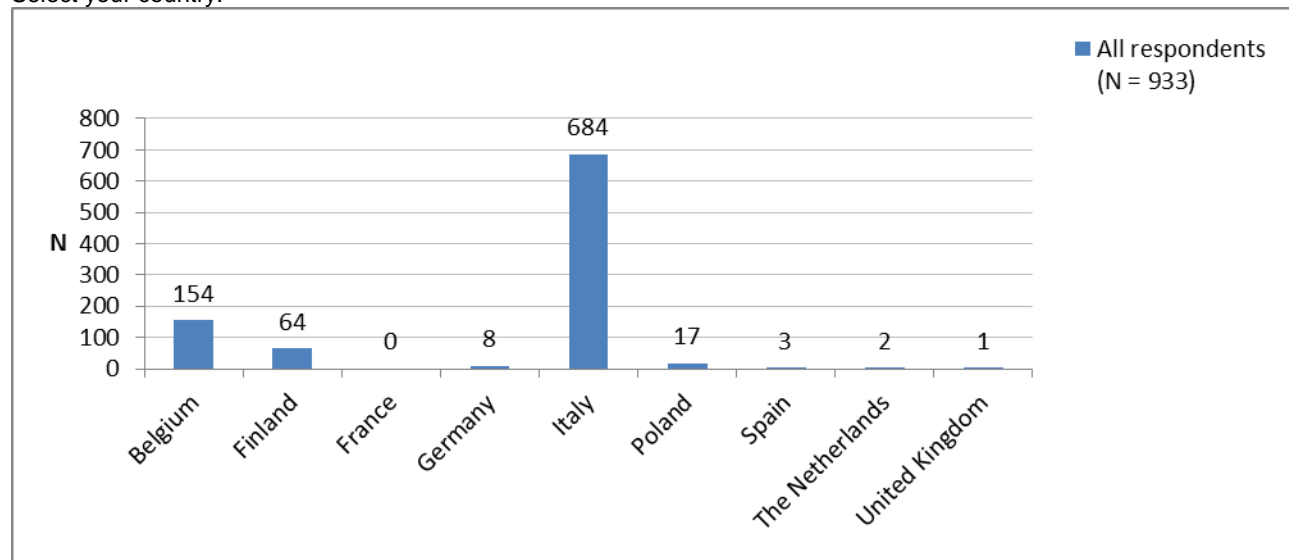
- General background information; country, area, case study, type of district, ...
- Stakeholders => target groups for further questions
- Expectations for service level, functionality, final result => key performance indicators
- Services
- Business
- Technical solutions; traditional, STA, future;
- Networked activities / co-operation
- Future visions / new ideas

## Annex E Questions and results of web questionnaire

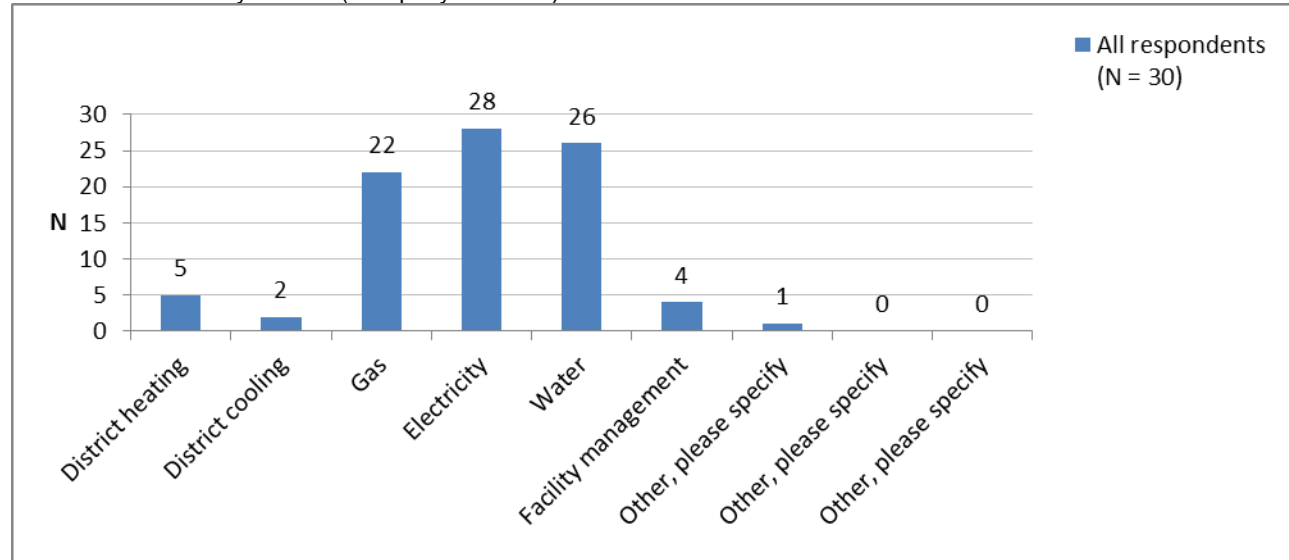
What is your stakeholder group (see Figure 3.2.1)?



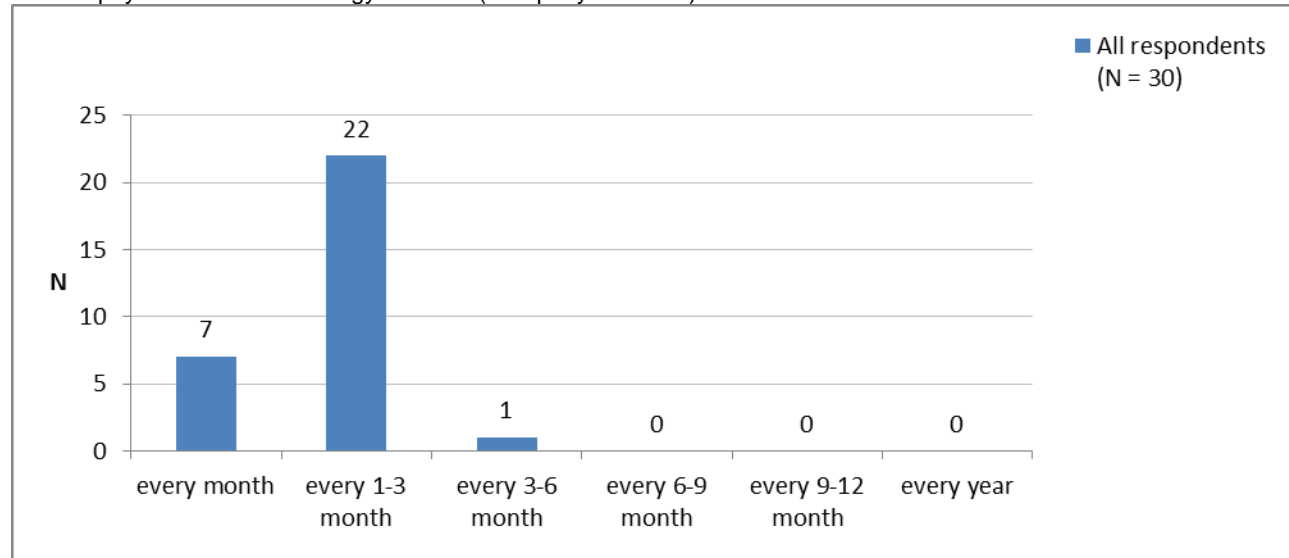
Select your country:



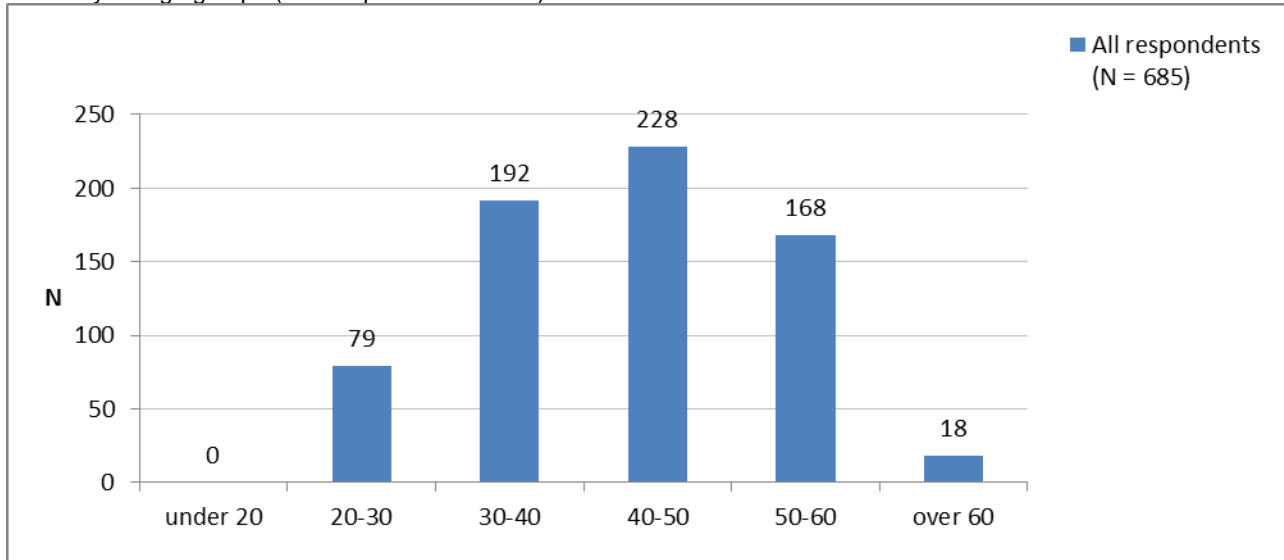
Select what services you have (Company end user)



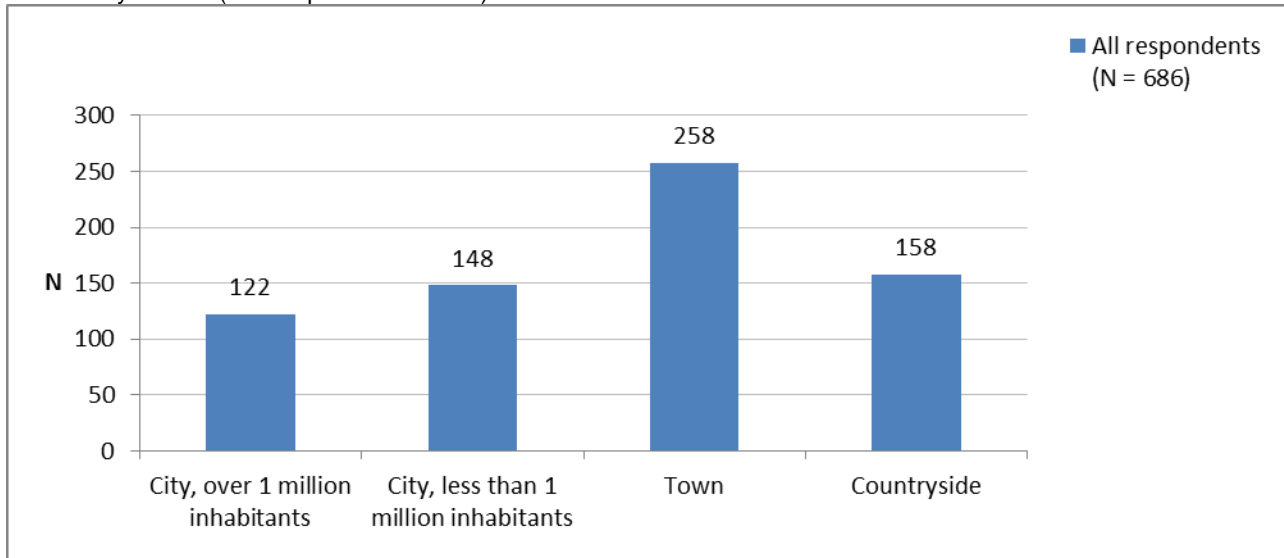
Current payment model for energy services (Company end user)



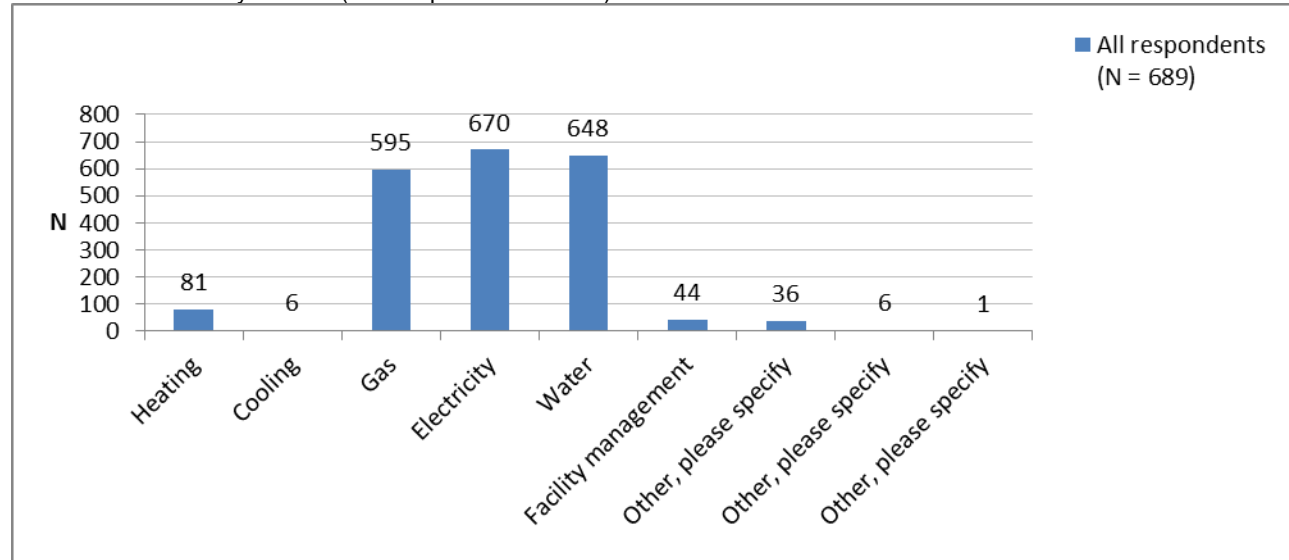
What is your age group? (Private person end user)



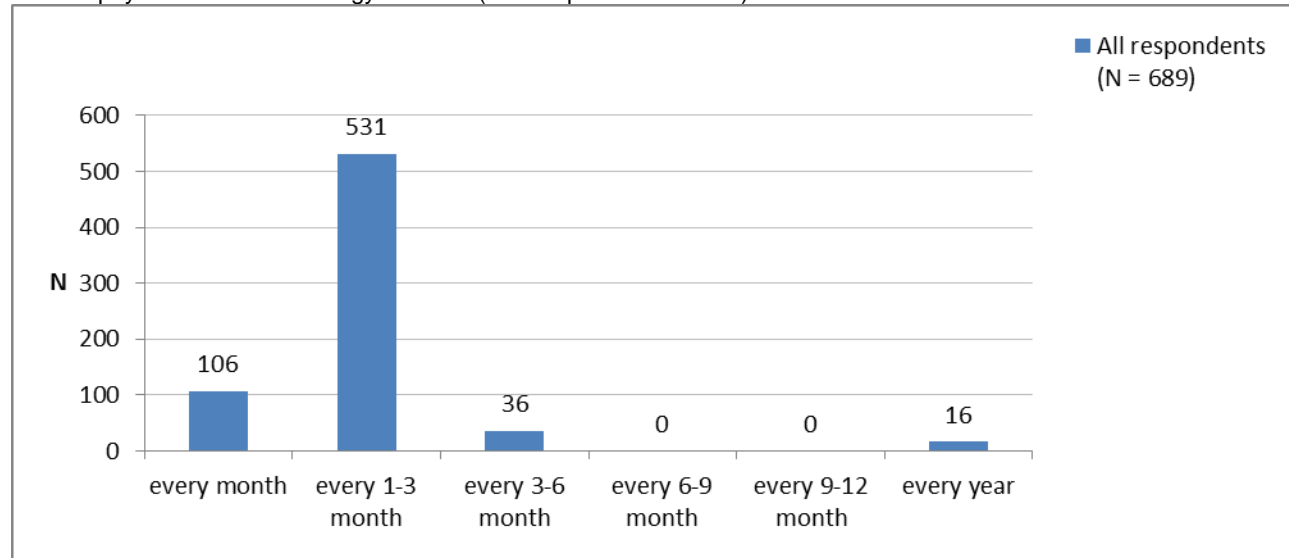
Where do you live? (Private person end user)



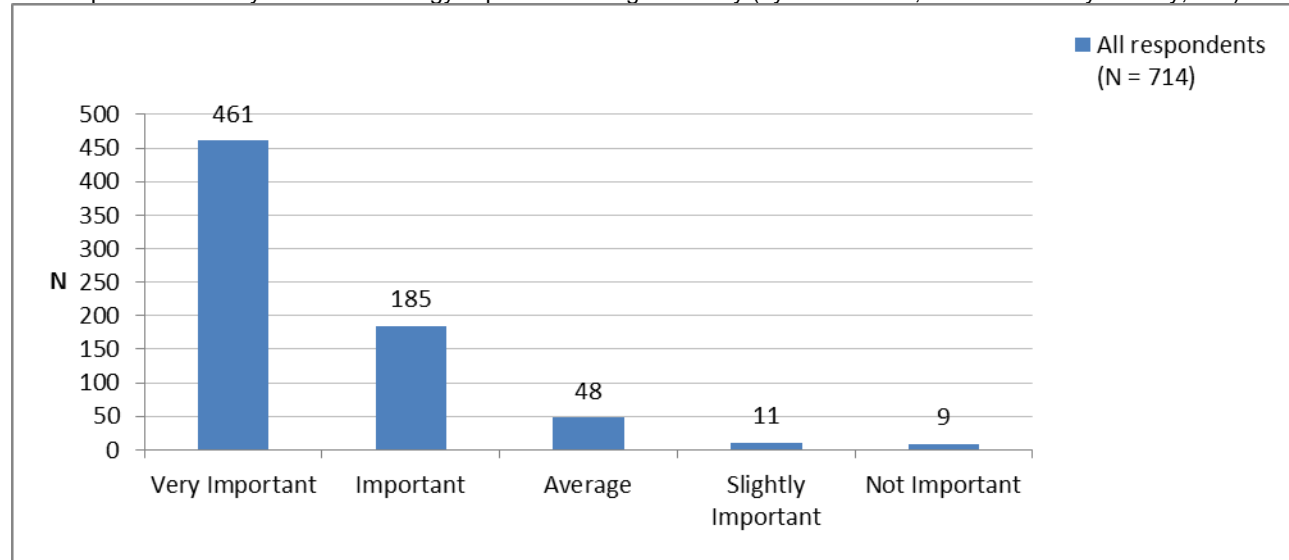
## Select what services you have (Private person end user)



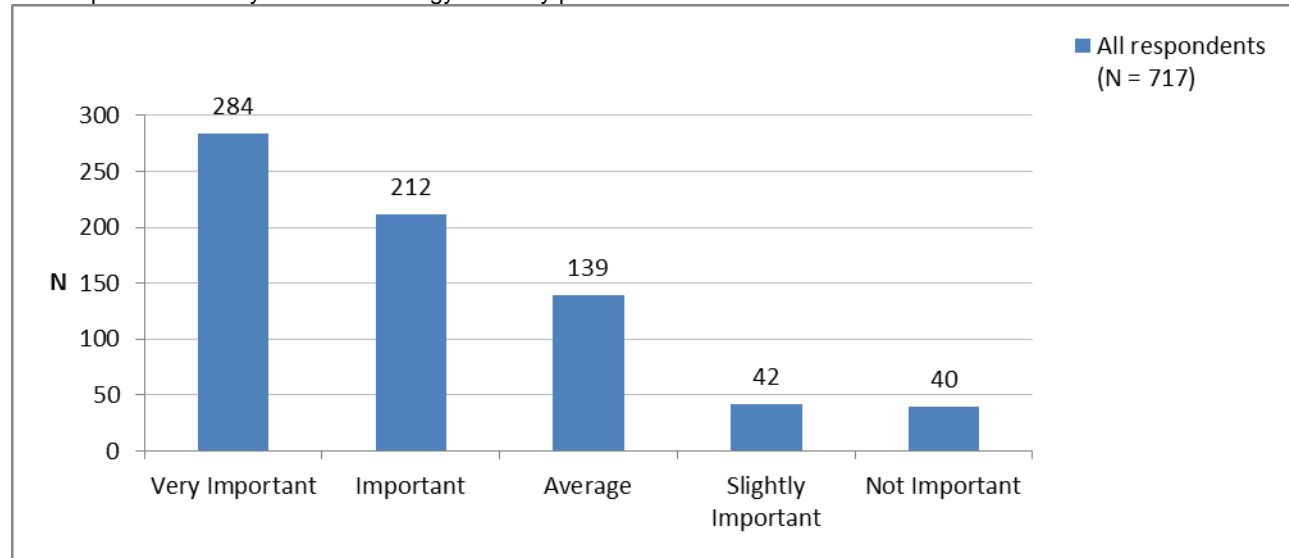
## Current payment model for energy services (Private person end user)



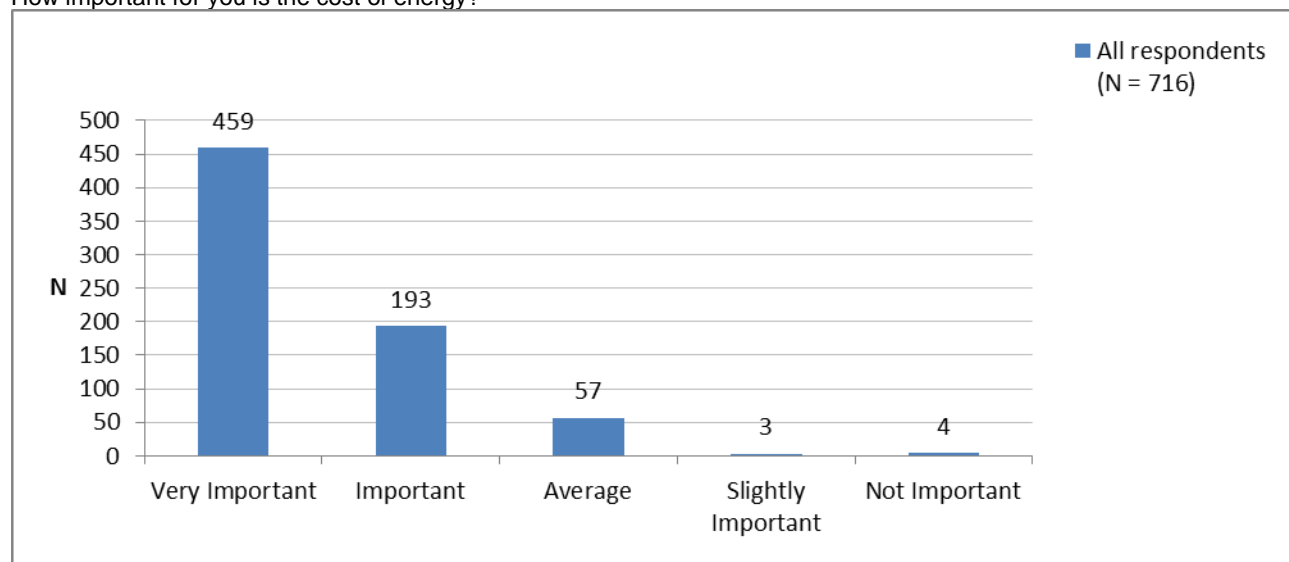
How important is it for you that the energy is produced in "green" way (by renewables, environmentally friendly, etc.)?



How important is it for you that the energy is locally produced?

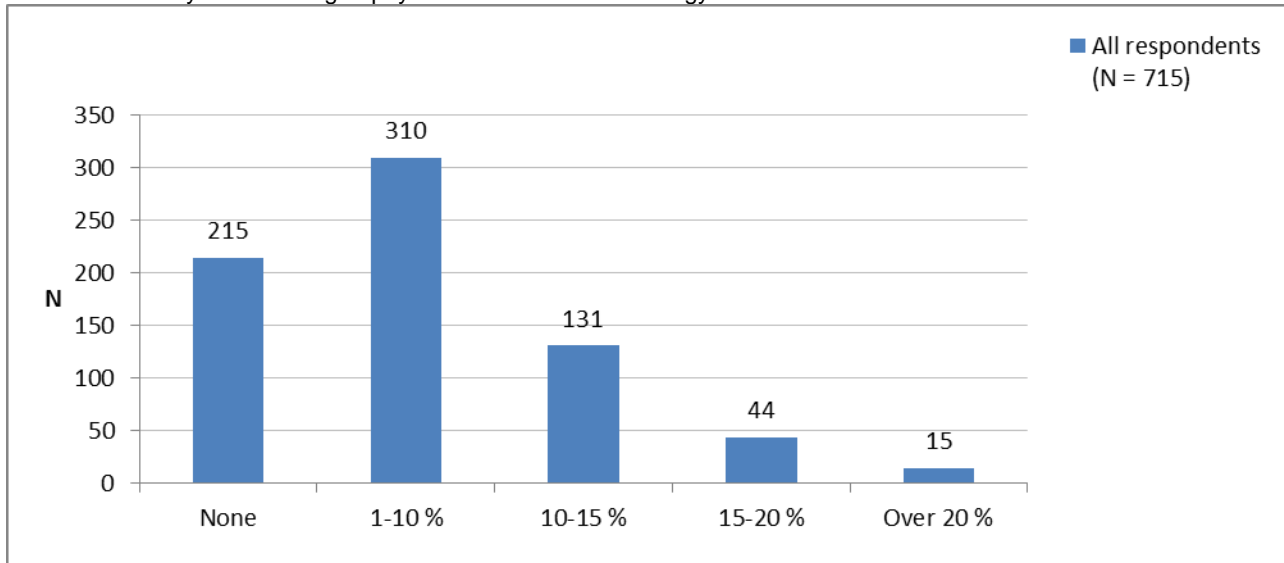


How important for you is the cost of energy?

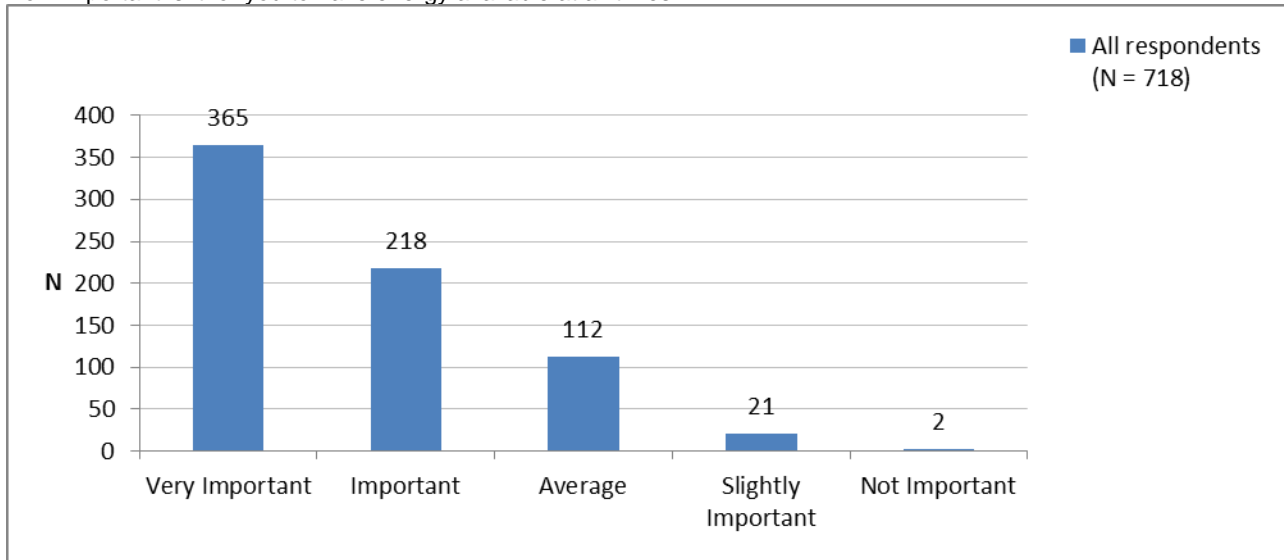




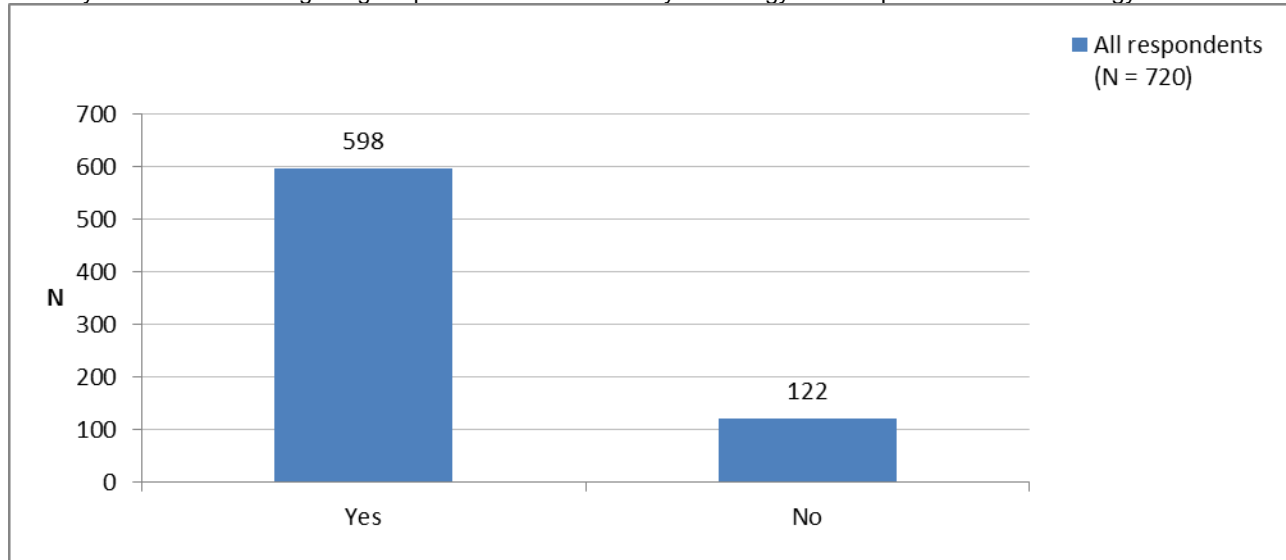
How much extra you are willing to pay for 100% renewable energy?



How important is it for you to have energy available at all times?

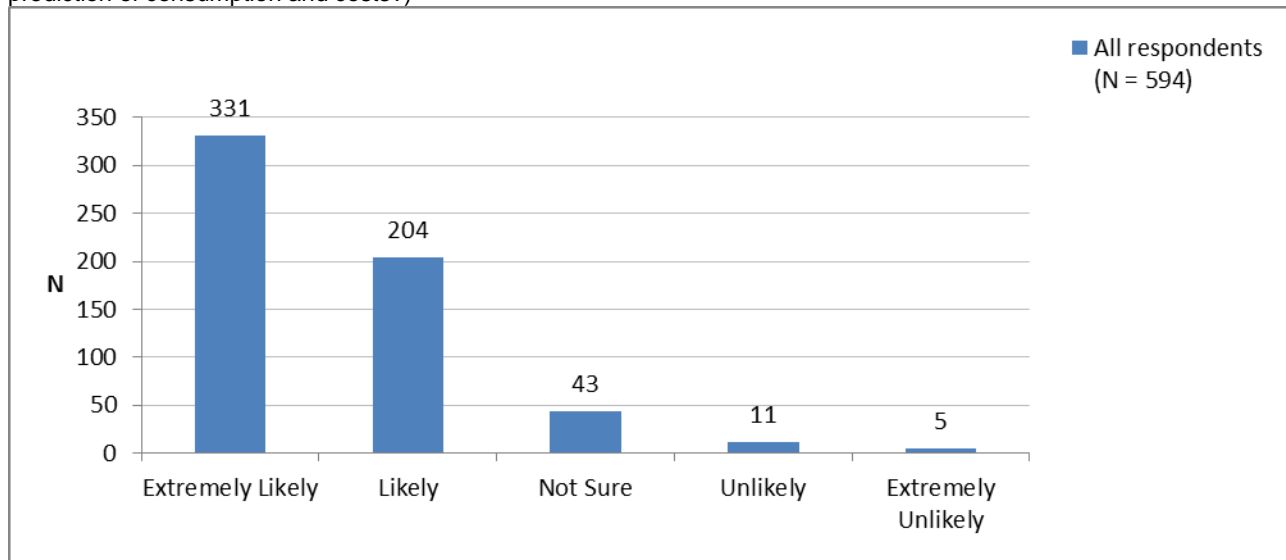


Would you be interested in getting frequent information about your energy consumption and cost of energy?

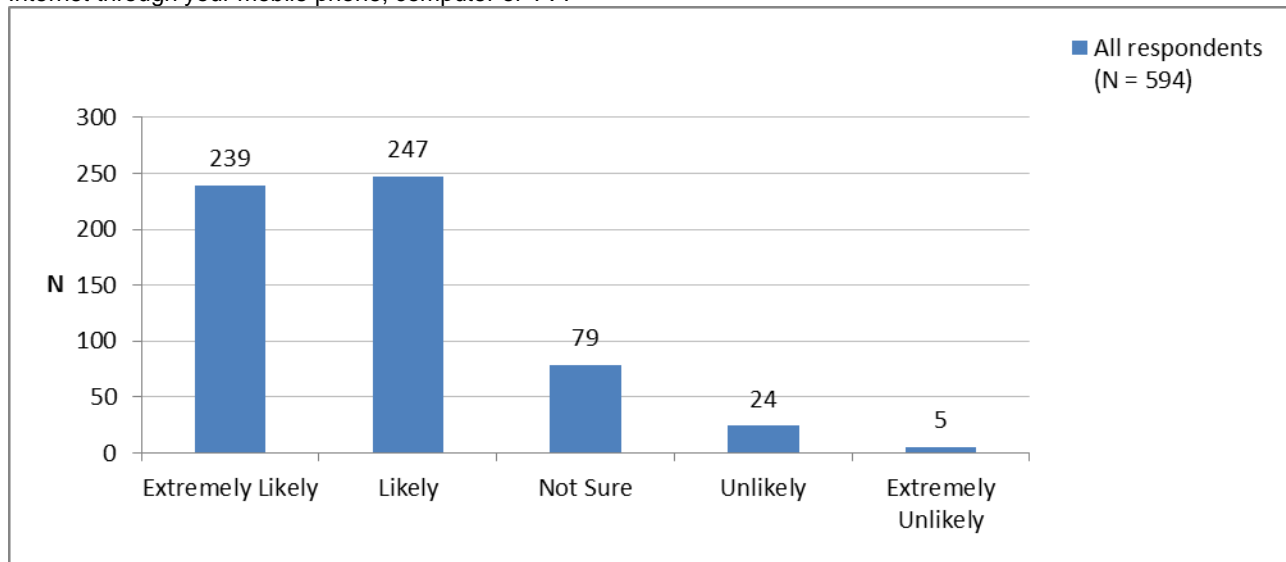


How likely is it that you would use a smart meter and adjust your energy consumption according to the data shown by the smart meter?

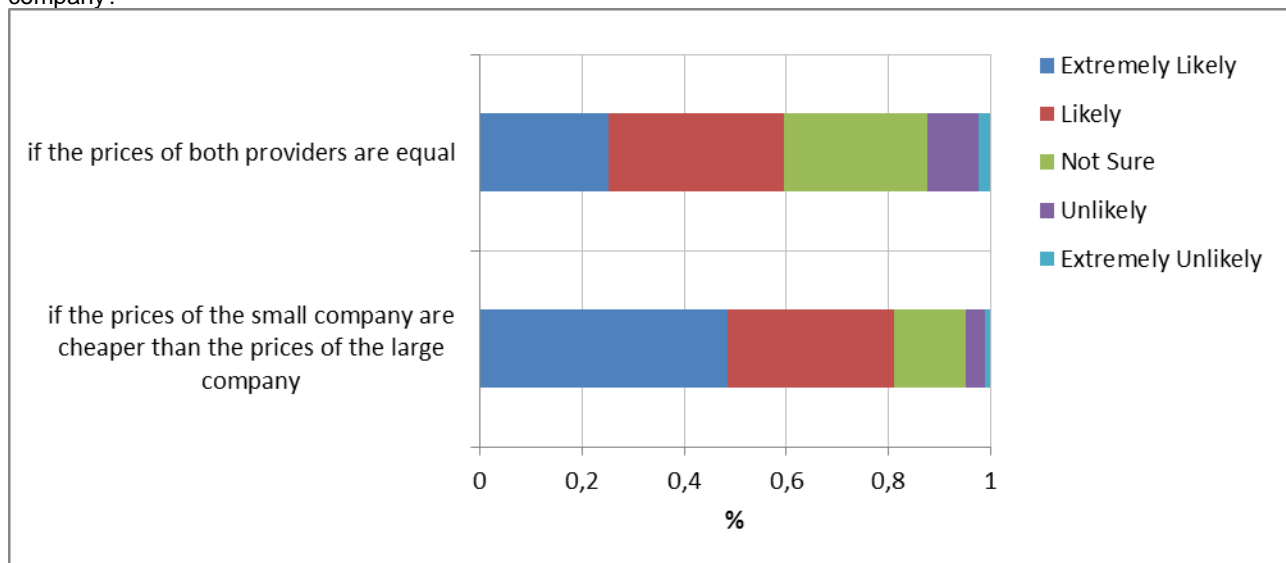
(smart meter shows the energy, heat and/or water consumptions of your house, cost of the consumption, and prediction of consumption and costs?)



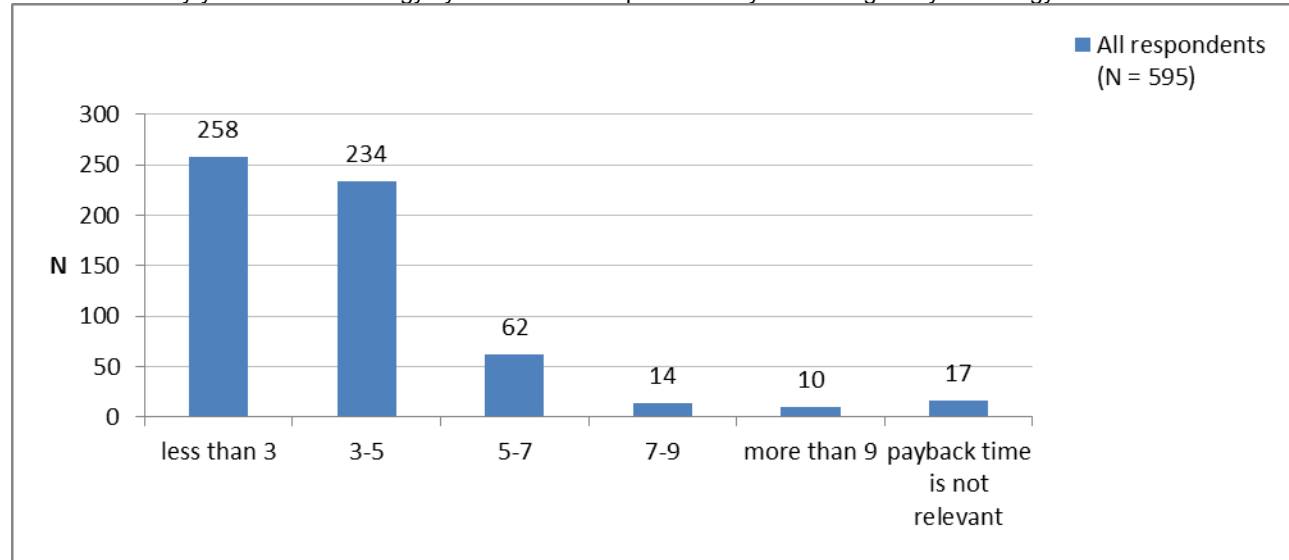
Would you like to use a smart energy management system (including security service) which would managed from the Internet through your mobile phone, computer or TV?



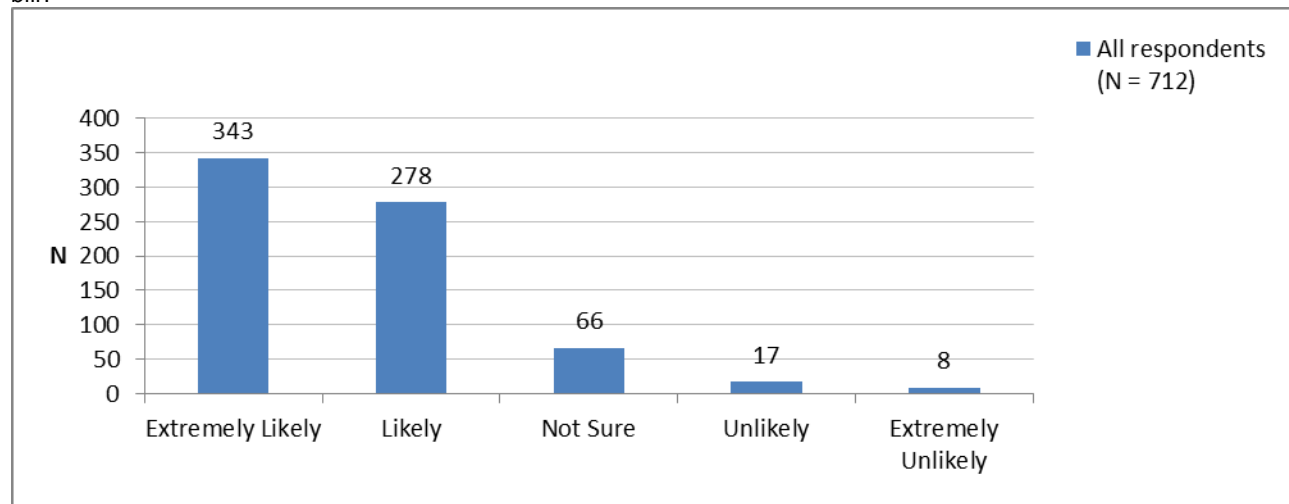
How likely is it that you would buy the smart energy management system to your home from a small company than from a large energy company?



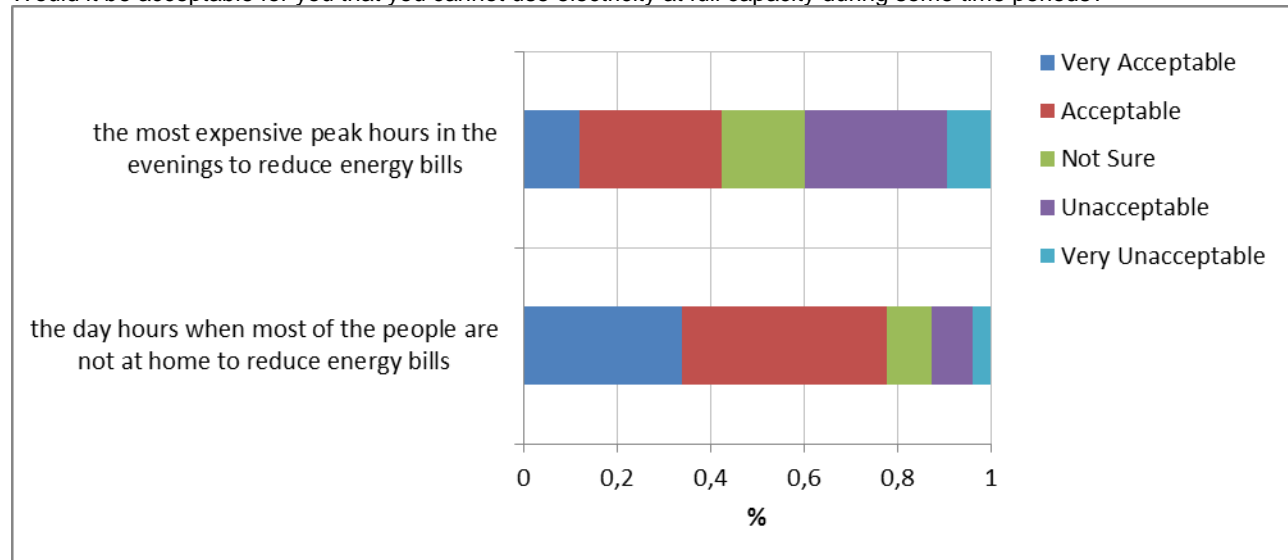
Within how many years a smart energy system should be paid back by the savings on your energy bill?



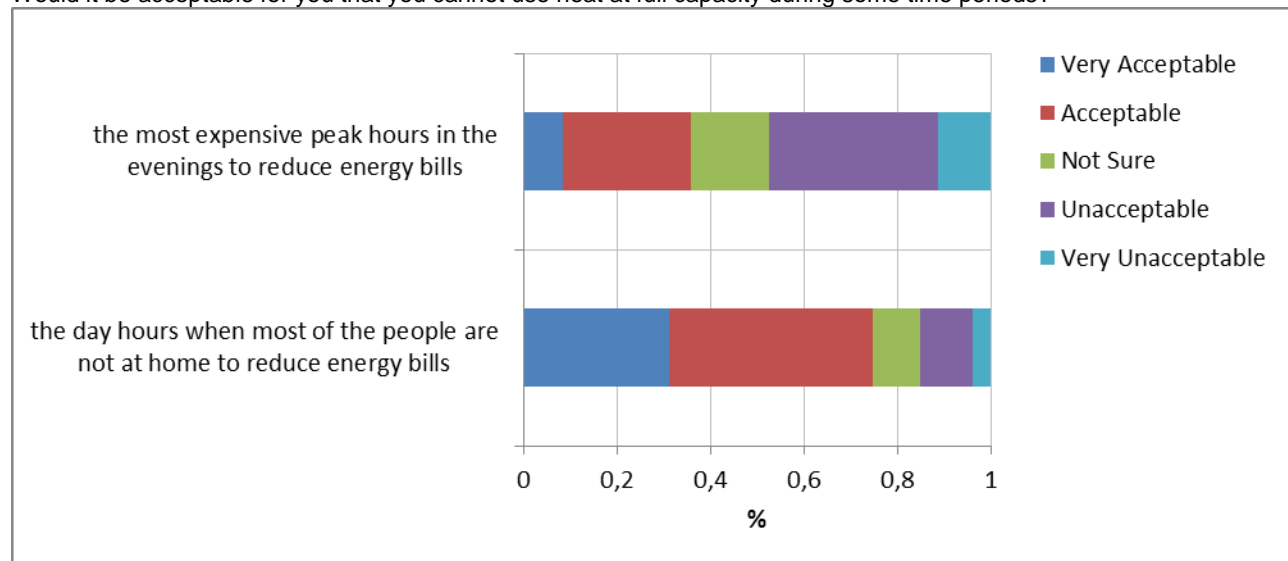
How likely is it that you would use a smart energy service (provided by an energy service provider) that automatically minimizes your home's energy consumption and energy bill?



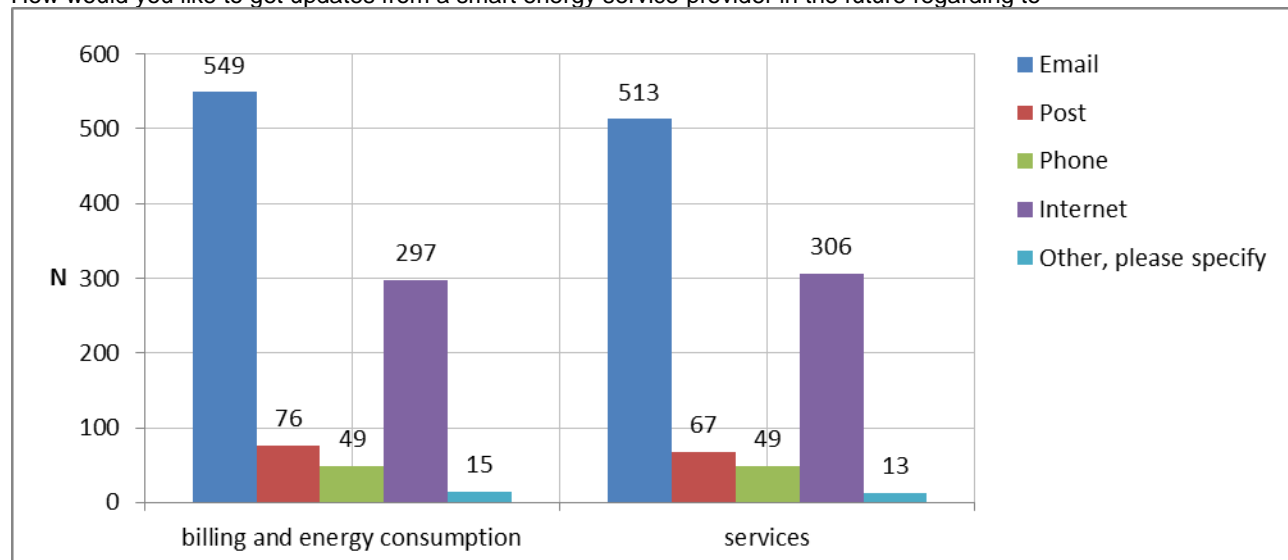
Would it be acceptable for you that you cannot use electricity at full capacity during some time periods?



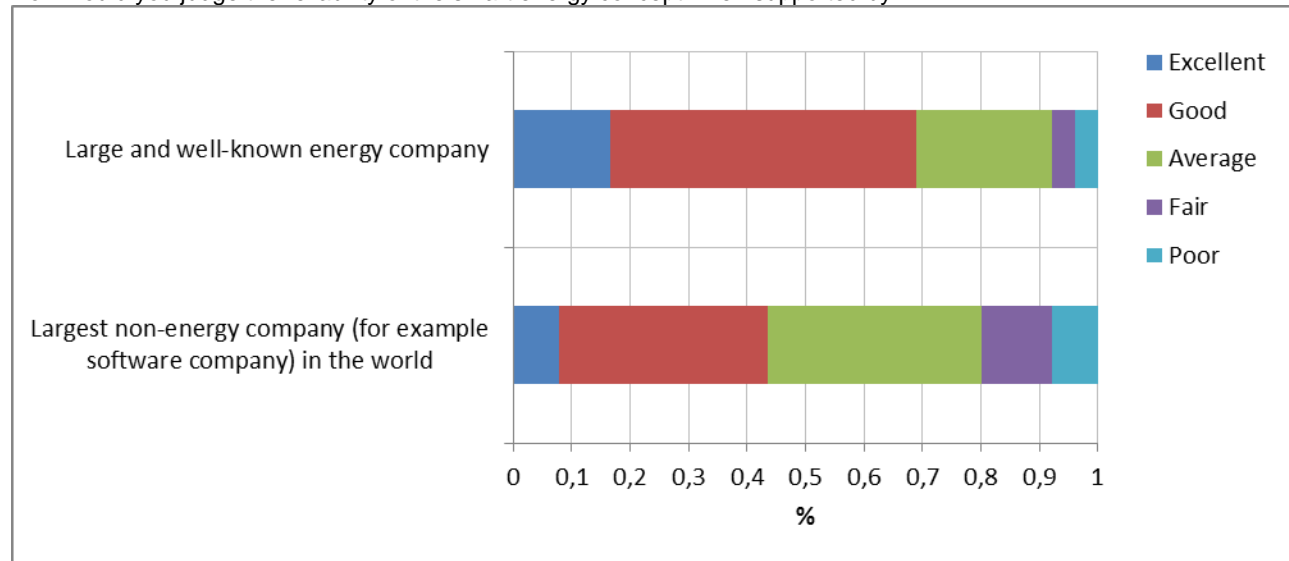
Would it be acceptable for you that you cannot use heat at full capacity during some time periods?



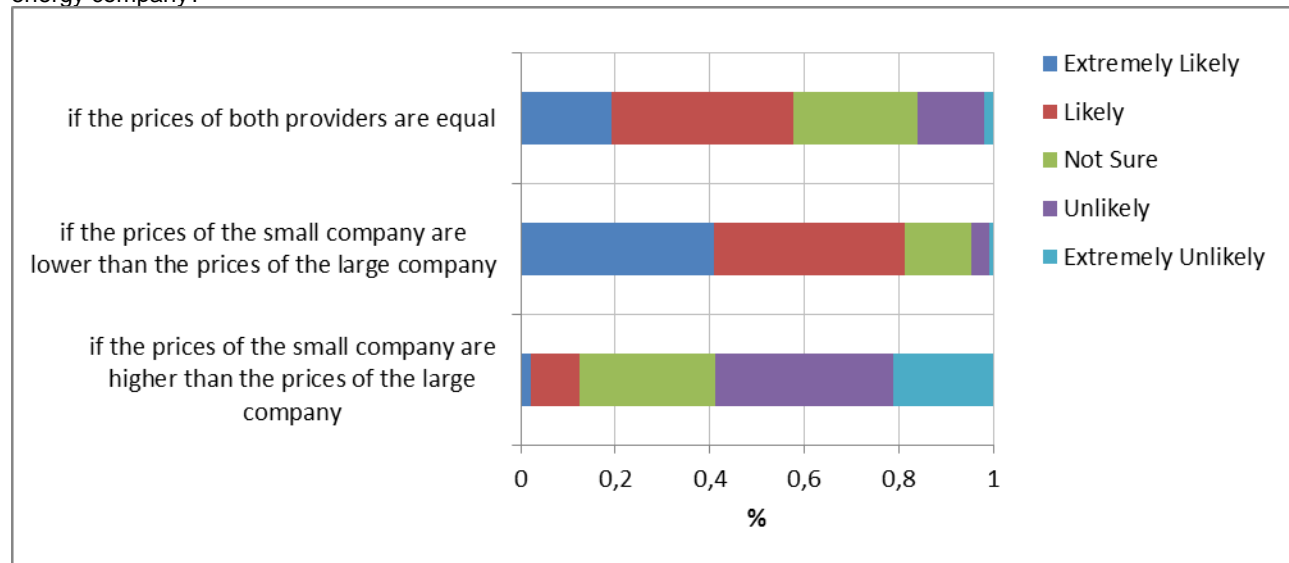
How would you like to get updates from a smart energy service provider in the future regarding to



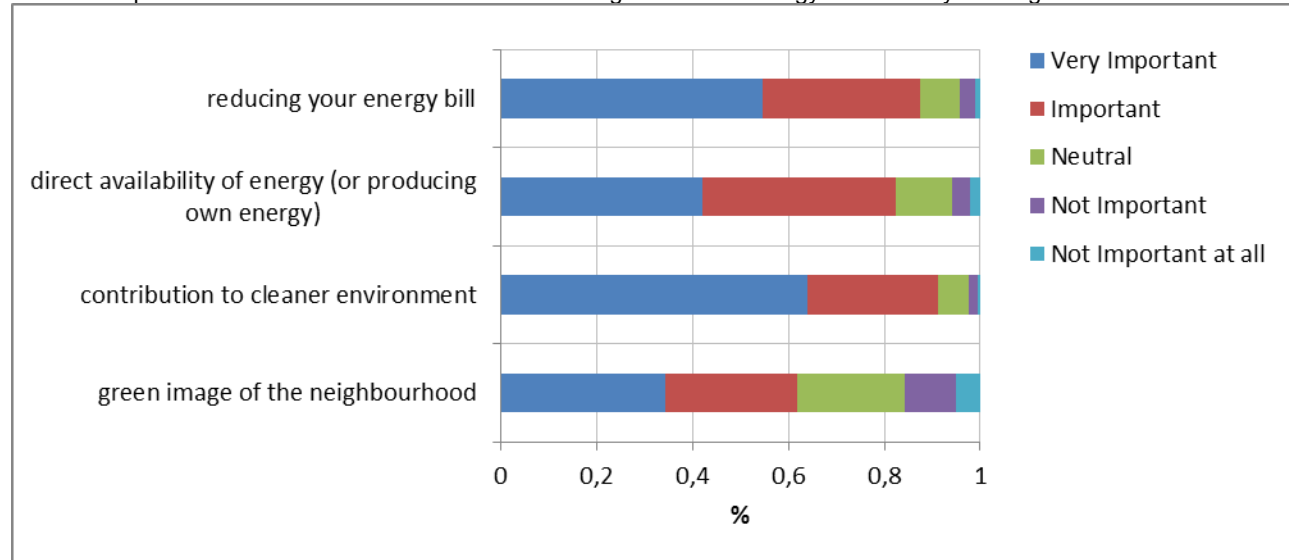
How would you judge the reliability of the smart energy concept when supported by



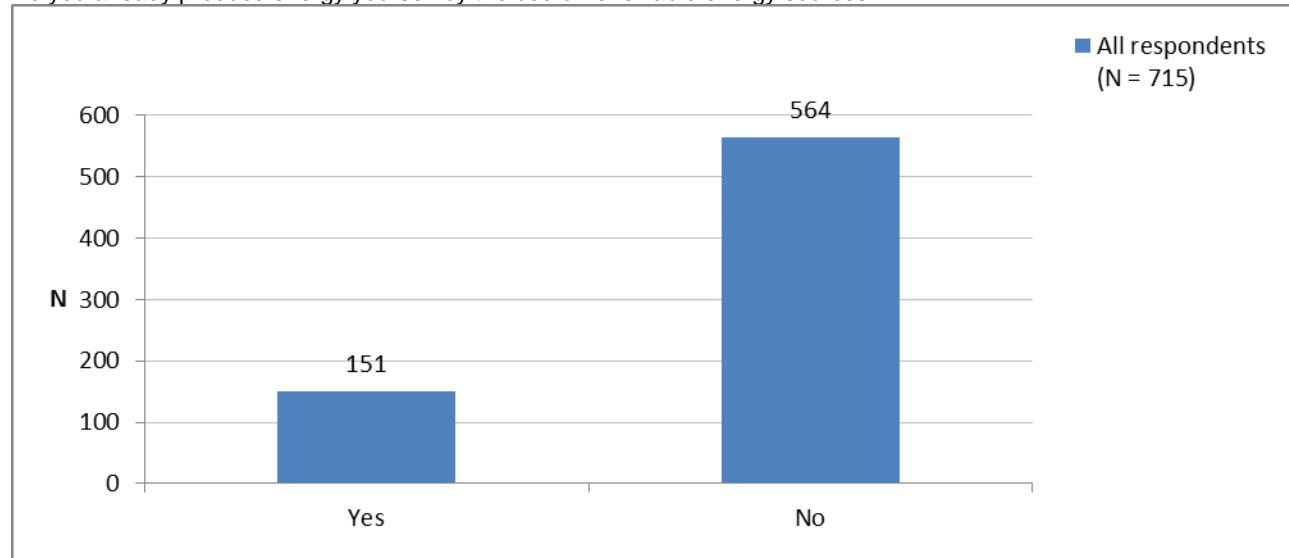
How likely is it that you would buy the smart energy service from a local small company rather than from a large energy company?



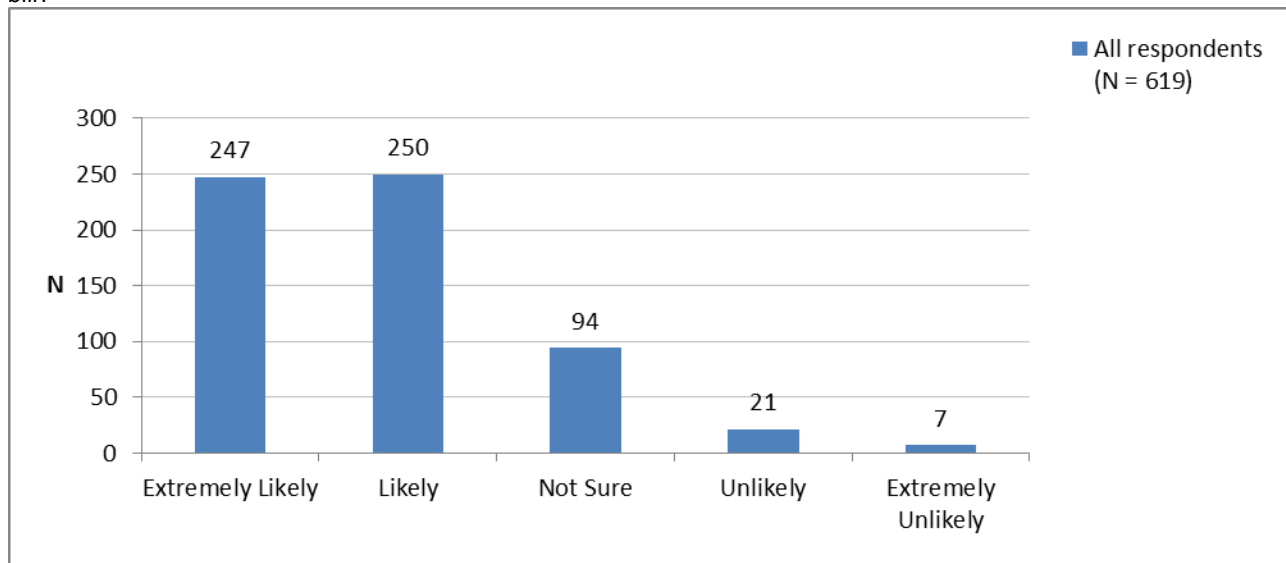
Rate the importance of below mentioned benefits of using renewable energy sources in your neighbourhood



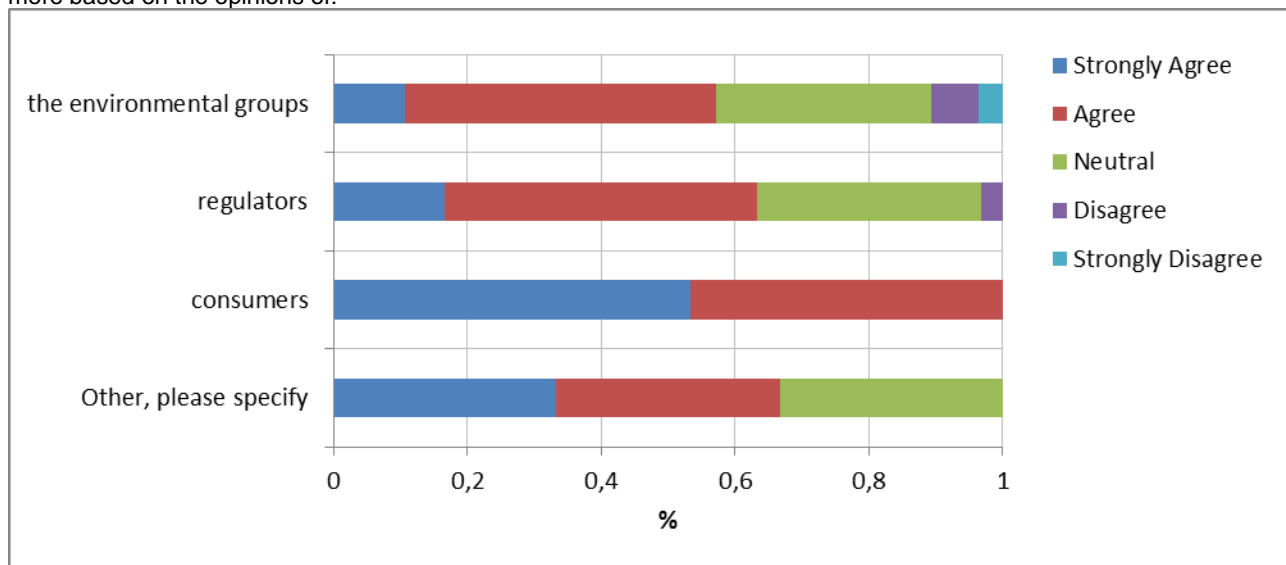
Do you already produce energy yourself by the use of renewable energy sources?



If you do not already produce energy by renewable energy sources, how likely would you do so in the future to reduce your energy bill?

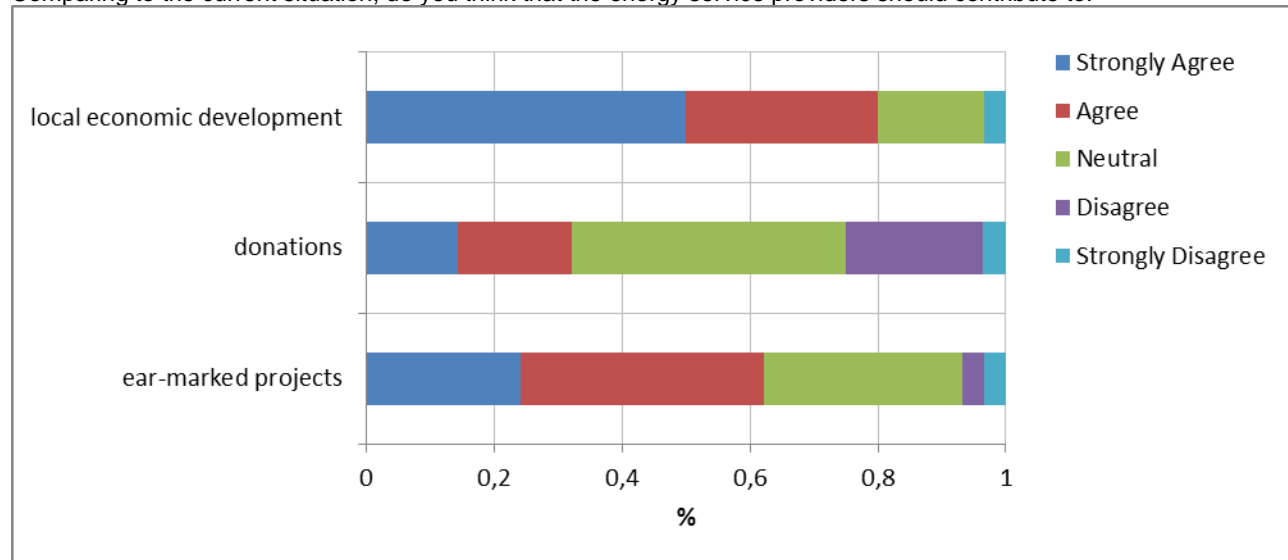


Comparing to the current situation, do you think that the energy service providers should listen and make decisions more based on the opinions of:

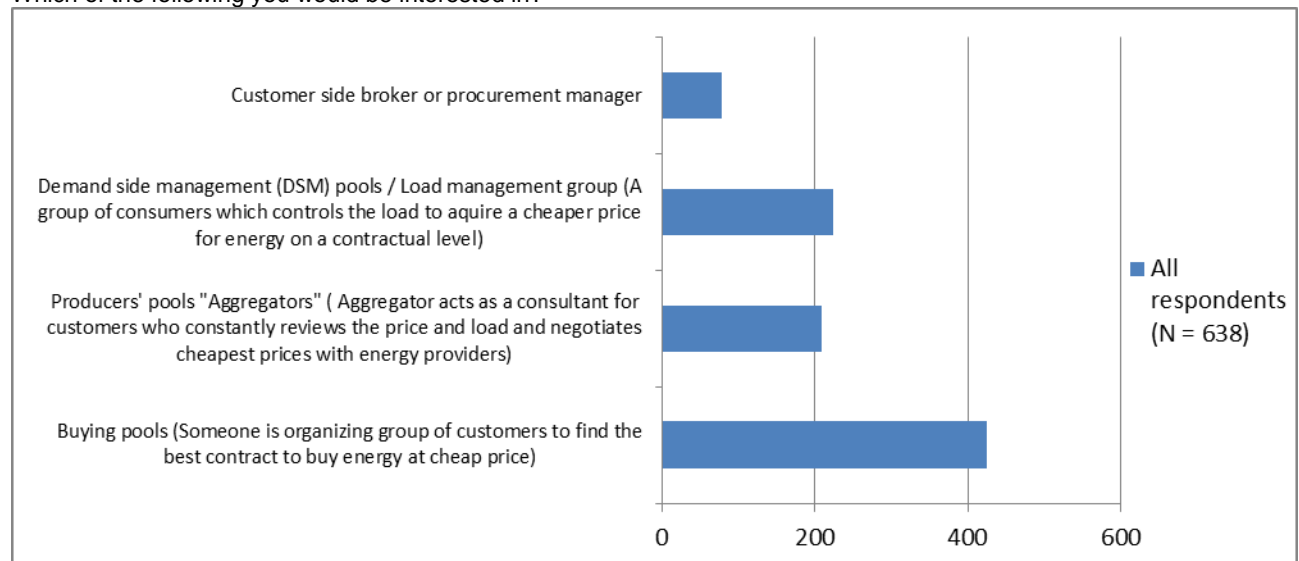




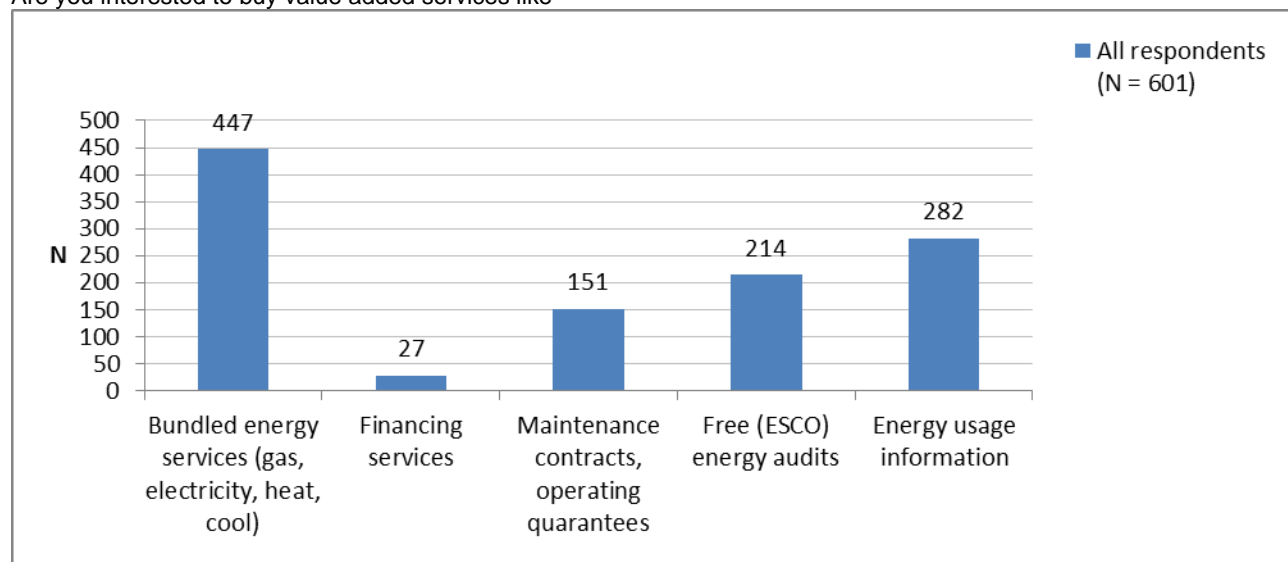
Comparing to the current situation, do you think that the energy service providers should contribute to:



Which of the following you would be interested in?

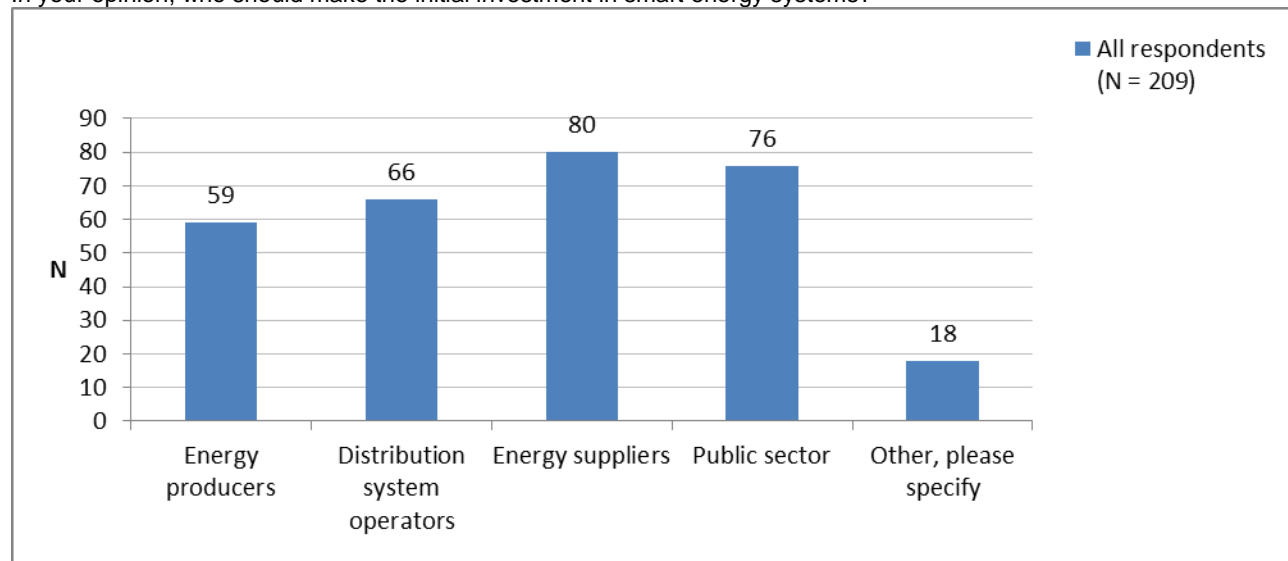


Are you interested to buy value added services like

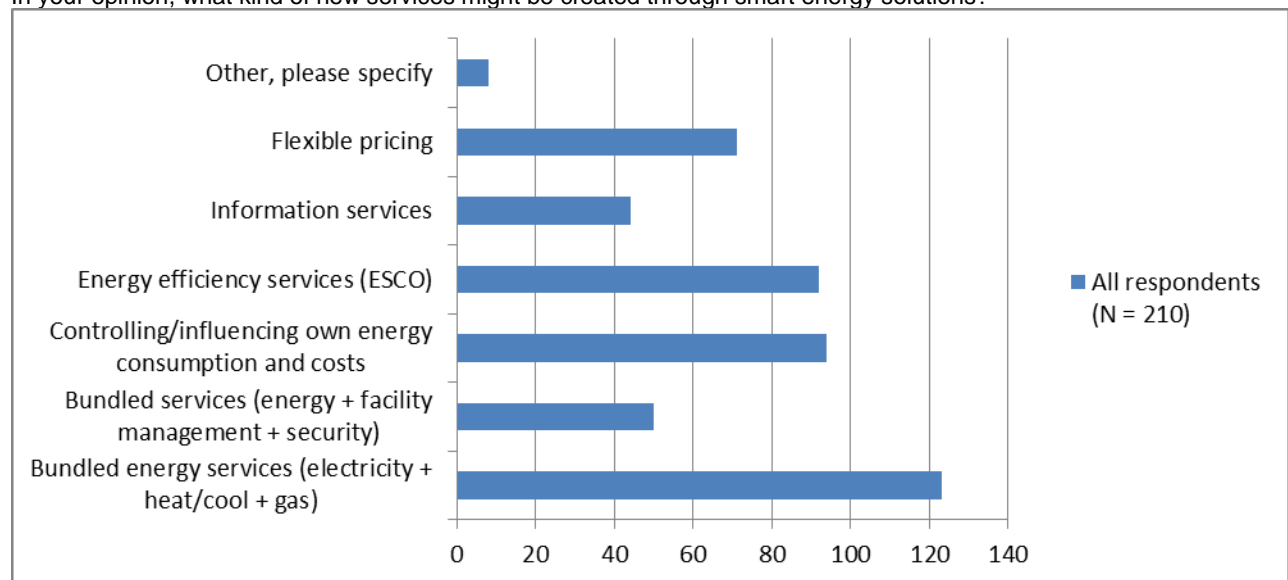


**The questions below were directed for stakeholder groups other than end users**

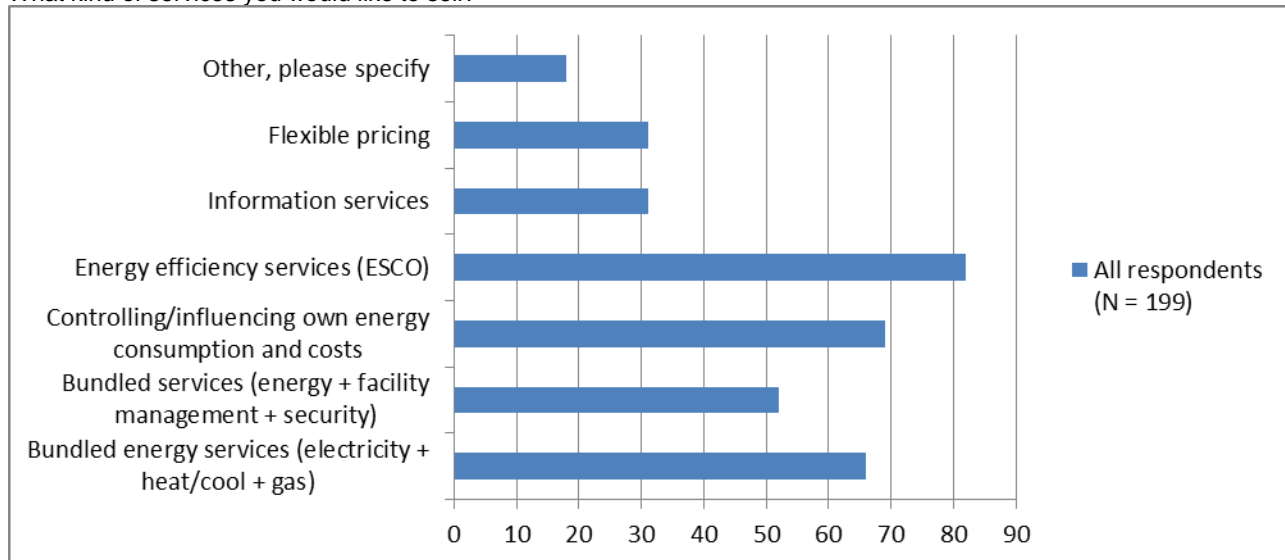
In your opinion, who should make the initial investment in smart energy systems?



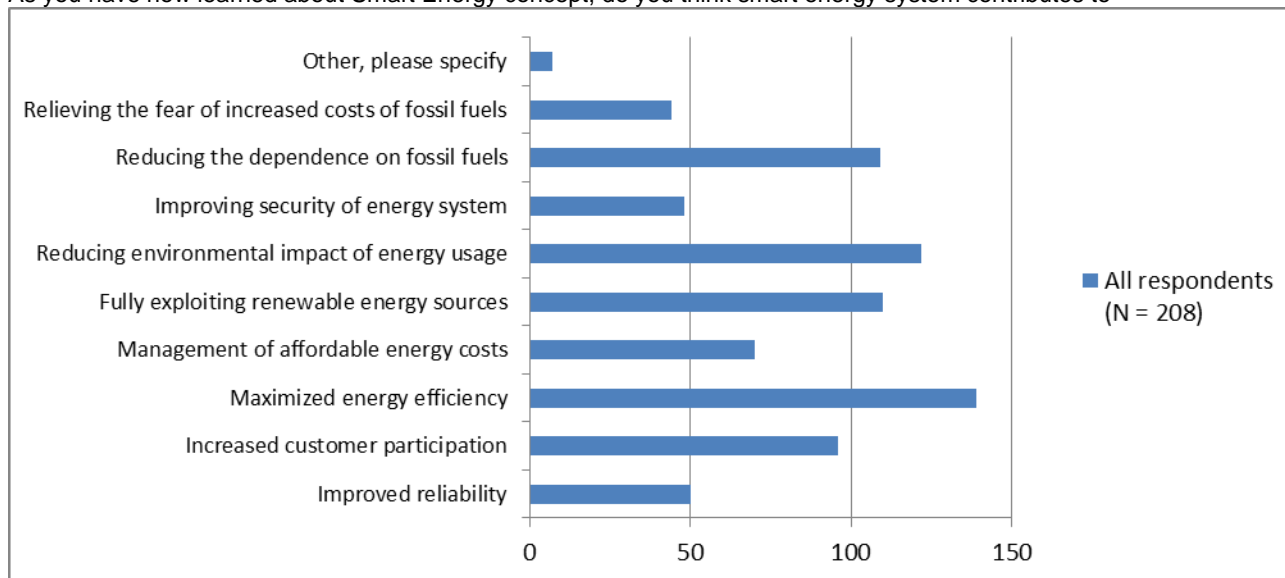
In your opinion, what kind of new services might be created through smart energy solutions?



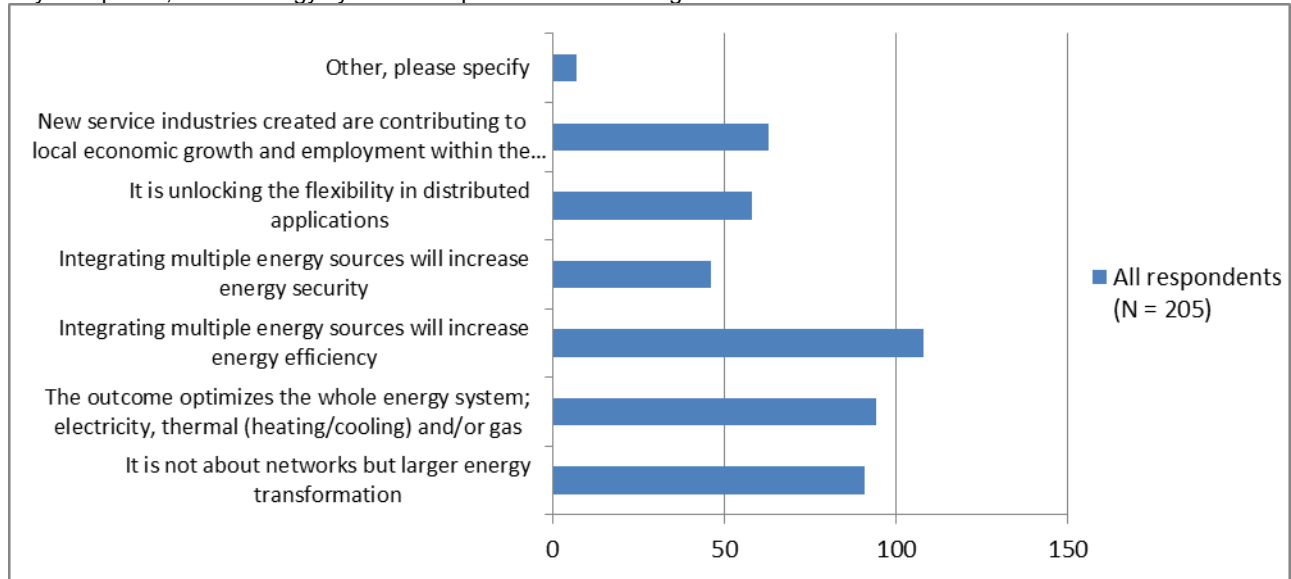
What kind of services you would like to sell?



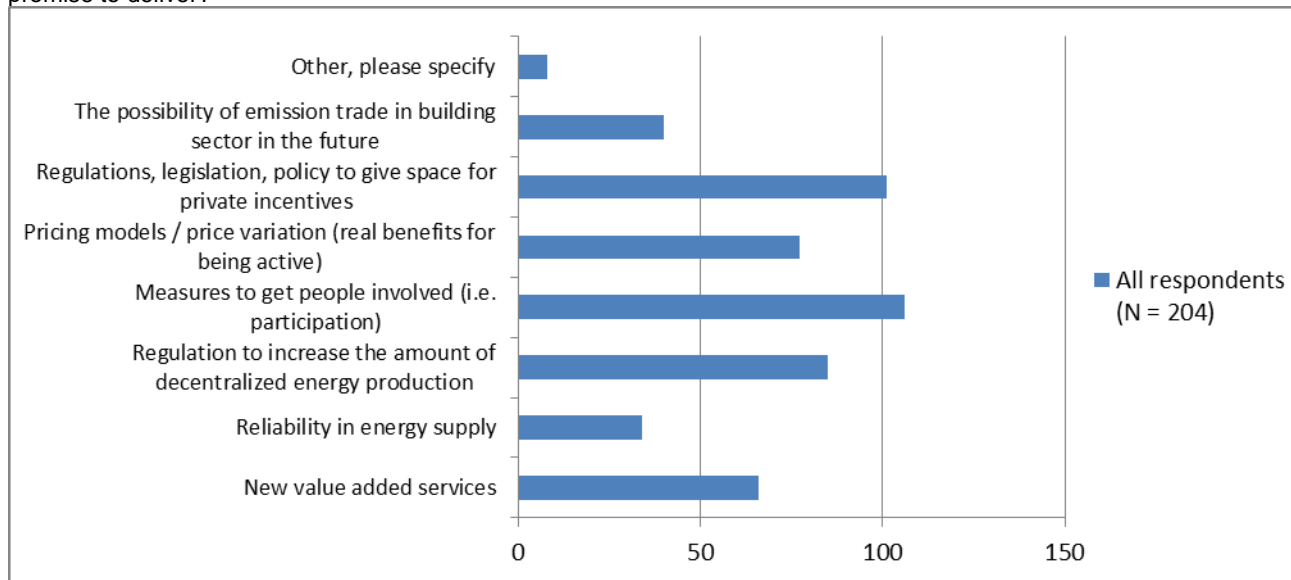
As you have now learned about Smart Energy concept, do you think smart energy system contributes to



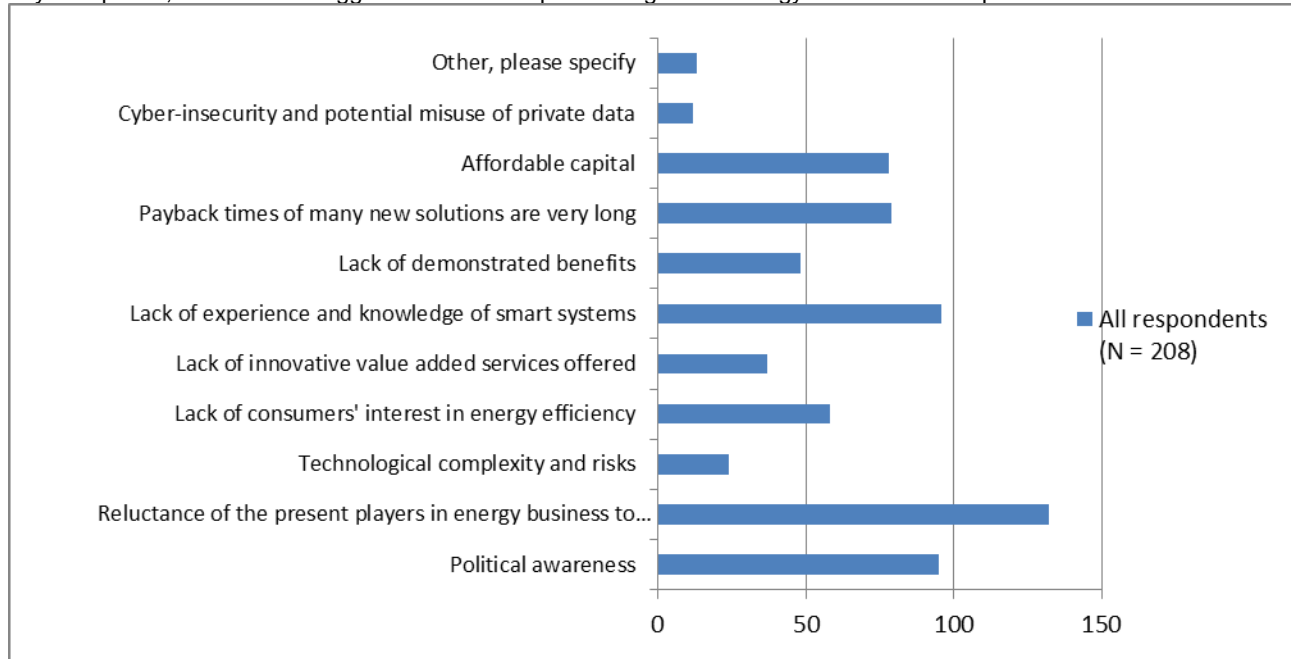
In your opinion, smart energy systems are preferable to smart grids because



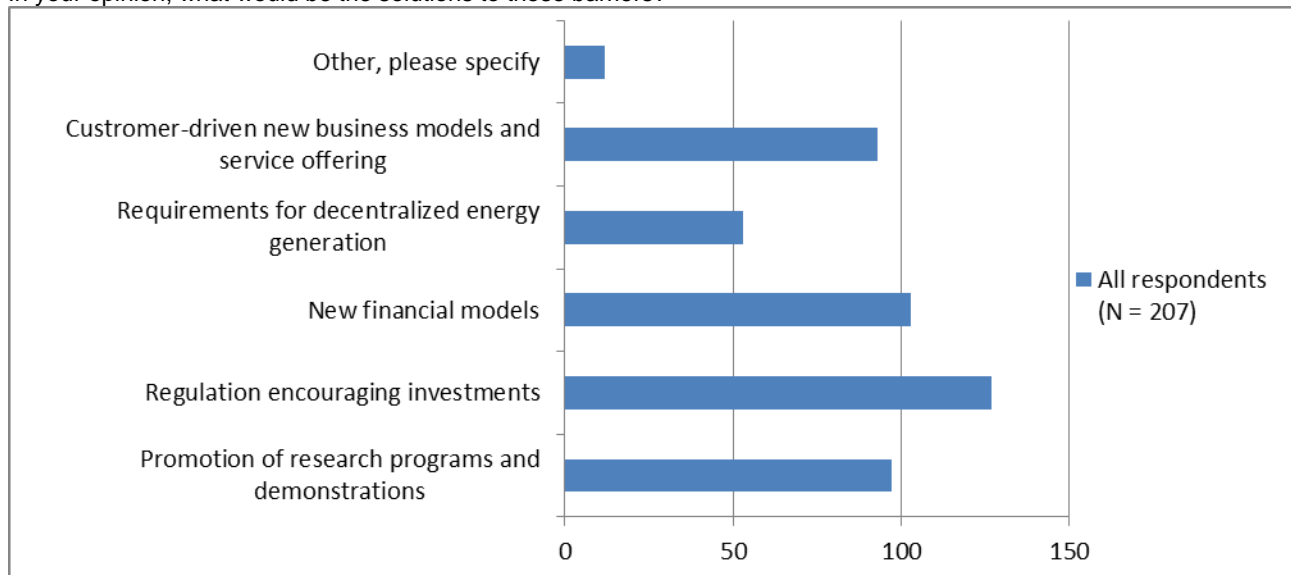
In your opinion, what would be possible ways to ensure that smart energy solutions really bring the benefits they promise to deliver?



In your opinion, what are the biggest barriers in implementing smart energy districts on Europe?



In your opinion, what would be the solutions to these barriers?



## Annex F      Research questions for the workshops and interviews

### Goals for workshops/interviews

Describe the current and possible new services and business models in district energy

Description of market needs and business models (concept, content, earning logics, financing models and risk management) in area of district level energy services

Case focused workshops / interviews:

- review E-HUB project cases and their non-technical issues
- identify and benchmark alternatives to current solutions

Topics:

- Service scope
- Service contracting
- Stakeholders involved
- Roles and responsibilities;
- Value chain & interactions between stakeholders
- Description of the business model, using e.g. Osterwalder's model
- Customer (end-user) interaction
- Business (ICT) solutions
- Risks, barriers, drivers, incentives
- Legal aspects
- Financing aspects
- Cost-benefit aspects

## Annex G Risk factors, risk matrix and success factor tables.

Categorised catalogue of PPP/PFI project risk factors [Bing et al, 2005]

Categorised catalogue of PPP/PFI project risk factors

Risk meta-level	Risk factor category group	Risk factor
Macro level risks	Political and government policy	<ul style="list-style-type: none"> <li>• Unstable government</li> <li>• Expropriation or nationalisation of assets</li> <li>• Poor public decision-making process</li> <li>• Strong political opposition/hostility</li> </ul>
	Macroeconomic	<ul style="list-style-type: none"> <li>• Poor financial market</li> <li>• Inflation rate volatility</li> <li>• Interest rate volatility</li> <li>• Influential economic events</li> </ul>
	Legal	<ul style="list-style-type: none"> <li>• Legislation change</li> <li>• Change in tax regulation</li> <li>• Industrial regulatory change</li> </ul>
	Social	<ul style="list-style-type: none"> <li>• Lack of tradition of private provision of public services</li> <li>• Level of public opposition to project</li> </ul>
	Natural	<ul style="list-style-type: none"> <li>• Force majeure</li> <li>• Geotechnical conditions</li> <li>• Weather</li> <li>• Environment</li> </ul>
Meso level risks	Project selection	<ul style="list-style-type: none"> <li>• Land acquisition (site availability)</li> <li>• Level of demand for project</li> </ul>
	Project finance	<ul style="list-style-type: none"> <li>• Availability of finance</li> <li>• Financial attraction of project to investors</li> <li>• High finance costs</li> </ul>
	Residual risk	<ul style="list-style-type: none"> <li>• Residual risks</li> </ul>
	Design	<ul style="list-style-type: none"> <li>• Delay in project approvals and permits</li> <li>• Design deficiency</li> <li>• Unproven engineering techniques</li> </ul>
	Construction	<ul style="list-style-type: none"> <li>• Construction cost overrun</li> <li>• Construction time delay</li> <li>• Material/labour availability</li> <li>• Late design changes</li> <li>• Poor quality workmanship</li> <li>• Excessive contract variation</li> </ul>
Micro level risks	Operation	<ul style="list-style-type: none"> <li>• Insolvency/default of sub-contractors or suppliers</li> <li>• Operation cost overrun</li> <li>• Operational revenues below expectation</li> <li>• Low operating productivity</li> <li>• Maintenance costs higher than expected</li> <li>• Maintenance more frequent than expected</li> </ul>
	Relationship	<ul style="list-style-type: none"> <li>• Organisation and co-ordination risk</li> <li>• Inadequate experience in PPP/PFI</li> <li>• Inadequate distribution of responsibilities and risks</li> <li>• Inadequate distribution of authority in partnership</li> <li>• Differences in working method and know-how between partners</li> </ul>
	Third party	<ul style="list-style-type: none"> <li>• Lack of commitment from either partner</li> <li>• Third Party Tort Liability</li> <li>• Staff Crises</li> </ul>

An example about risk allocation tables [based on Immonen, 2005 & L. Bing et al, 2005]

Project:					
Respondent:					
Customer / bidder / sub contractor, other?					
Main category	Sub category	Risk factor	Risk allocation		
A. Macro level risks			Client	Bidder	Shared
	Political and government policy				Description of allocation principles
		_ Unstable government			
		_ Expropriation or nationalisation of assets			
		_ Poor public decision-making process			
		_ Strong political opposition/hostility			
	Macroeconomic				
		_ Poor financial market			
		_ Inflation rate volatility			
		_ Interest rate volatility			
		_ Influential economic events			
	Legal				
		_ Legislation change			
		_ Change in tax regulation			
		_ Industrial regulatory change			
	Social				
		_ Lack of tradition of private provision of public services			
		_ Level of public opposition to project			
	Natural				
		_ Force majeure			
		_ Geotechnical conditions			
		_ Weather			
		_ Environment			
B. Meso level risks					
	Project selection				
		_ Land acquisition (site availability)			
		_ Level of demand for project			
	Project finance				
		_ Availability of finance			
		_ Financial attraction of project to investors			
		_ High finance costs			
	Residual risk				
		_ Residual risks			
	Design				
		_ Delay in project approvals and permits			
		_ Design deficiency			
		_ Unproven engineering techniques			
	Construction				
		_ Construction cost overrun			
		_ Construction time delay			
		_ Material/labour availability			
		_ Late design changes			
		_ Poor quality workmanship			
		_ Excessive contract variation			
		_ Insolvency/default of sub-contractors or suppliers			
	Operation				
		_ Operation cost overrun			
		_ Operational revenues below expectation			
		_ Low operating productivity			
		_ Maintenance costs higher than expected			
		_ Maintenance more frequent than expected			



C. Micro level risks						
	Relationship					
		_ Organisation and co-ordination risk				
		_ Inadequate experience in PPP/PFI				
		_ Inadequate distribution of responsibilities and risks				
		_ Inadequate distribution of authority in partnership				
		_ Differences in working method and know-how between partners				
		_ Lack of commitment from either partner				
	Third party					
		_ Third Party Tort Liability				
		_ Staff Crises				
** Risk factors from L.Bing. et al, 2005						

## Critical success factors and success sub-factors for Public-Private Partnership (PPP) projects [Zhang, 2005]

Critical success factor	Success subfactor
Favorable investment environment	(1) Stable political system; (2) Favorable economic system; (3) Adequate local financial market; (4) Predictable currency exchange risk; (5) Predictable and reasonable legal framework; (6) Government support; (7) Supportive and understanding community; (8) The project is in public interest; (9) Predictable risk scenarios; (10) The project is well suited for privatization; and (11) Promising economy.
Economic viability	(1) Long-term demand for the products/services offered by the project; (2) Limited competition from other projects; (3) Sufficient profitability of the project to attract investors; (4) Long-term cash flow that is attractive to lender; and (5) Long-term availability of suppliers needed for the normal operation of the project.
Reliable concessionaire consortium with strong technical strength	(1) Leading role by a key enterprise or entrepreneur; (2) Effective project organization structure; (3) Strong and capable project team; (4) Good relationship with host government authorities; (5) Partnering skills; (6) Rich experience in international PPP project management; (7) Multidisciplinary participants; (8) Sound technical solution; (9) Innovative technical solution; (10) Cost-effective technical solution; (11) Low environmental impact; and (12) Public safety and health considerations.
Sound financial package	(1) Sound financial analysis; (2) Investment, payment, and drawdown schedules; (3) Sources and structure of main loans and standby facilities; (4) Stable currencies of debts and equity finance; (5) High equity/debt ratio; (6) Low financial charges; (7) Fixed and low interest rate financing; (8) Long-term debt financing that minimizes refinancing risk; (9) Abilities to deal with fluctuations in interest/exchange rates; and (10) Appropriate toll/tariff level(s) and suitable adjustment formula.
Appropriate risk allocation via reliable contractual arrangements	Appropriate and reliable risk allocation in: (1) Concession agreement; (2) Shareholder agreement; (3) Design and construct contract; (4) Loan agreement; (5) Insurance agreement; (6) Supply agreement; (7) Operation agreement; (8) Offtake agreement; and (9) Guarantees/support/comfort letters.

## Annex H New service and pricing models for district heating

New service models	
RajaLämpö (2005):	
Financing solutions	
Financing for the construction	
Leasing-solution	
New equipment	
Heat distribution centre	Alarm system for the heat distribution centre
	Remote monitoring for the heat distribution centre
	Remote use system for the heat distribution centre
	Construction of for the heat distribution centre
	Heat distribution centre well
	Quarter heat distribution centre
	Colour ordering service
Energy meter producers	Metering modul for tariff information
	Data transmission unit for optimisation
	Data transmission unit into the heat distribution room
	Energy metering information data collection unit in the district heating network control
	Processor and data transmission appliance of metering information for the district heating network control
	An intermediate metering point in the distribution network
	Real estate service centre to the heat distribution centre
Automation system	Information transmission unit for the real estate control
	Information transmission unit for billing
	Transmission unit for the HVAC consumption information
	Data collection unit for district heating control
	District heating network analysing equipment
	Data processing appliance for district heating control
	Mobile information collecting appliance
	Data processing and analysing of the control system
	Digital mechanic
	Apartment or user specific heat consumption evaluation
	Humidity sensor for the heat distribution room
	Humidity sensor for living and ancillary areas
	An outdoor remote screen of the heat distribution centre control centre
	An indoor remote screen of the heat distribution centre control centre
	Remote use device for the heat distribution centre control centre
	Maintenance diary for the control centre
	Attaching the maintenance diary to the control centre
	Automation of the melting system
	General control for the HVAC
	Transmission system of the consumption and metering information
	Logbook of the heat distribution centre
	Humidity metering control
	Alarm centre for controlling small houses
	Network information collection software
Heat production and the district heating network	Backup kettle service
	Network as leasing
	Renting the district heating network to a third party
	Heat network expert
The heating system of a building	Data transfer unit for the room thermostat
	Intelligent radiator ventilator
	Alarms for the heating system of a buildings
	Distance control and use system for the heating of a building
	Courtyard melting system

System products	
Billing information management for new tariffs	
Safe heat reporting to the customer database	
Use optimisation focus of the district heating network with help of building metering	
Metering information management for maintenance system	
Centralized control room for customer appliances	
Metering information management and a transmission system	
Distance use system for heat distribution centre	
Distance use system for heating devices	
Utilization of customer metering in district heating network control	
Information service for the district heating network	
Services	
Inspection services	District heating inspection
	Yearly inspection of heating appliances
	Evaluation of the condition of district heating appliances
	Testing of district heating appliances
	Inspection book for heat distribution centre
	Opening activities for the heating season
	Use phase inspection
	Inspection service for the network owner
	Error control room
Consultation services	Instruction for the time of absence
	Interfaces of seasons
	Helpdesk
	Automatic consultation service for joining to district heating
	Reporting about consumption and feedback automation
User services	Continuous follow-up
	User service of district heating network for heat provider
	Heating service of the building
	Energy saving consultation
	Indoor air of the building
Maintenance services	Yearly maintenance service
	Spare part service
	A maintenance contract for the district heat company
Connection services	Planning service for a new connection
	Installation service for a new customer
	District heat appliance procurement and construction service for the customer
	"Keys in hand" -solution
	Renovation package for large real estate owners
	Complete rebuilding package for the heat distribution centre
	Maintenance of different connections
	Grea value – connection package
Information services	Information storage
	Information transfer service
	Text message service
	Heating system consulting
	Database for comparing energy consumption
	Own bill - service
	Tariff tool
	Maintenance history of district heating appliances of the building
Energy-An Consulting (2009):	
Use and maintenance of the heating and domestic water network	
Renting the heat distribution centre and the connection to the customer	
Energy saving consulting to the customer	
Syvänen & Mikkonen (2011):	
Website for comparing different energy solutions. The website could also serve as a platform where users can share their thoughts and experiences.	
"Keys into the hand" –service, which covers the planning of the best suitable solution, permissions, installation as well as care and maintenance.	

<b>New pricing models</b>	
<b>Energy-An Consulting (2009):</b>	
Detached houses and low-energy buildings could be a special group who could be charged only with the energy fee.	
Separate pricing for production and transfer.	
Separate contract for customers with mixed heating, with an energy fee based on maximum and spare capacity	
Revision of the cost distribution of combined electricity and heat production	
A fixed annual fee based on the water flow and capacity	
Separate winter and summer prices for the energy fee.	
Separate fees for hot water and room heating, in addition to the fixed price.	
Partly transfer of the fixed costs to energy fees, which would motivate the customer to save energy.	
An annual maintenance fee, which covers the maintenance costs.	
Company providing a support payment for a customer who changes the existing heating system to district heating.	
An investment support by the government for a customer who transfers to district heating.	
<b>Connection fee</b>	Connection fee as an annual fee/ longer payment time
	Not collecting the connection fee or giving a discount for new customers
	Separating part of the connection fee into a pipe fee
	Connection fee based on water flow, power capacity or space of the building
	Longer payment time for connection fee (the customer can choose between paying right away or as a part of the fixed fee or the energy fee.
	A rental model, in which the customer does not pay the connection fee.
	A pricing model, in which connection fee covers the installed heat distribution centre and connecting to the distribution network
	A pricing model, in which connection fee includes also an agreed minimum amount of heating energy
	A pricing model, in which the consumption fee is included in the connection fee, so that the consumption fee stands for 1/3 of the total unit price
<b>Heikkilä (2011)</b>	
The dynamic determination of the energy fee.	
<b>Pesola et al. (2011)</b>	
Hourly-based pricing and billing	
Tariff discounts and compensation fees	

<b>Other solutions and methods</b>	
<b>Hagström et al., (2009)</b>	
Lighter district heating technologies	
Good holistic planning	
Comprehensive partnership between the construction company and the energy company	
<b>Klobut et al. (2009)</b>	
District heating combined with centralised ventilation heating	
Planning the area as a whole in order to dimension the network according to the consumption.	
<b>Larsson &amp; Persson (2012)</b>	
"Green" district heating	
<b>Pesola et al. (2011)</b>	
Hybrid heating systems and intelligent district heating solutions.	

## Annex I Interviews and workshop Finland

The Finnish study was done by one workshop with district heating companies and several interviews. Part of these interviews are reported earlier in (Kohonen *et al.*, 2011). The workshop with district heating industry was initialised with the state-of-the-art literature review of services and pricing methods in district heating sector.

### State-of-the-art of services and pricing methods in district heating

#### Introduction

District heating is facing new challenges as the construction of low-energy buildings will increase in the future, and new customers are needed to cover the decreased energy demand. To attract new customers and to maintain the competitiveness in the future it is necessary for district heating companies to develop new services and pricing models and, at the same time, continue highlighting the existing strengths (such as easiness and reliability) [Energy-An Consulting 2009; Pesola *et al.* 2011]. It has been argued that the customer surface of district heating can be developed and widened as there is space and demand for new solutions and that by adopting a service-oriented approach new and wider business opportunities for district heating companies might open up [Rajalämpö 2005].

#### District heating pricing

In Finland the price of district heating consists of three parts: **connection fee, basic fee and energy fee.**

The connection fee covers the construction of the district heating pipe to the technical utility room of the property as well as metering equipment for district heat. With this fee the company covers a part of the construction costs already at the beginning [Lampinen 2011]. Table 13 presents an example of connection fee in Finland, starting from 5900€ and depending on the length of the pipe and the agreed capacity. The price of the heat distribution centre (which is not included in the connection fee) for a detached or semi-detached house varies between 4 000 to 6 000 € [Vantaan energia 2011].

Table 13: District heating connection fees [Fortum Power and Heat Oy, 2012]

Capacity P (kW)	Connection fee ( € )	Length of the pipe included into the connection cost (m)
10-20	5 900	20 m
21 – 150	$3\,300 + 130 \times P$	30 m
151 – 500	$10\,050 + 85 \times P$	40 m
501 -	$33\,050 + 39 \times P$	40 m

The purpose of the basic fee is to divide the fixed costs caused by the activity between all customers. It is not based on the consumption because some of the costs are allocated to the use site or the customer and it is independent from the consumption or the size of the connection [Lampinen 2011]. The fee might be based on the heated area (cubic meters) of the buildings, and for example for a small detached houses it can be about 25 €/month [Jyväskylän energia Oy]. Instead of the basic fee, also a capacity fee can be used. In this case the price is determined by the actual measured capacity, and it might vary after a renovation for example). [Fortum 2012]

Energy fee is the unit price, according to which the customer is charged for the consumption. The energy fee should be the same for similar customers and it should either be a fixed price, or the fee can be based on a summer and winter tariff.

Figure 18 presents how the district heating price formation in case of a detached house and a multi-family building in Finland (Energiateollisuus 2011).

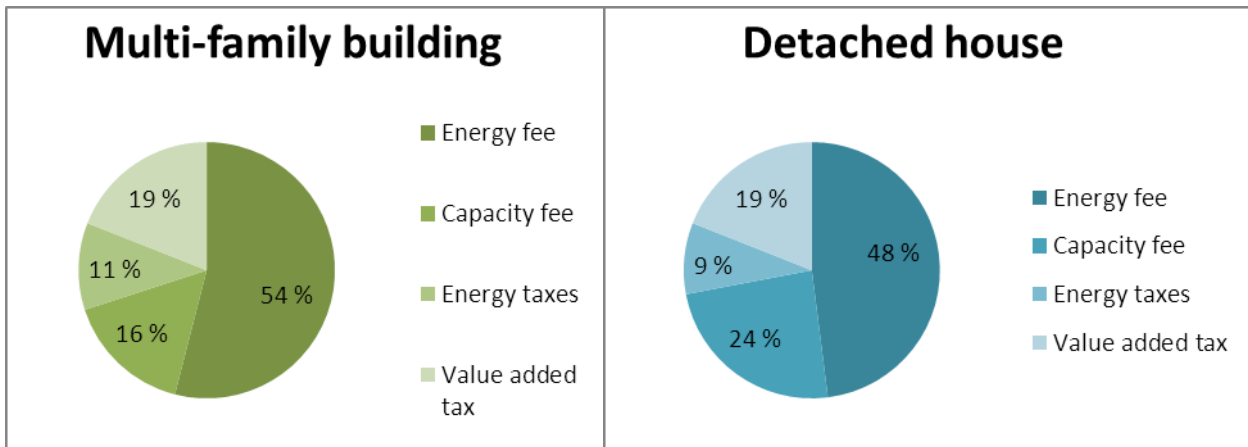


Figure 18. Formation of district heating price in multi-family buildings and detached houses (Energiateollisuus 2011).

### New pricing models

Several alternative pricing models have been created, many of which are related to lowering the connection fee, which forms an important obstacle for new customers to join the district heating network. Examples of new pricing models presented by Energy-An Consulting (2009) are listed below (see more examples from the annex H):

#### Related to the connection fee:

- **Renting the heat distribution centre** to the user: In this pricing model the customer avoids the connection fee. The company owns the connection and is therefore responsible for the use-, maintenance and replacement investment costs. The fixed payment (which might be slightly higher than in other pricing models) covers both fixed costs and the rental costs.
- **Connection fee, which also covers the installed heat distribution centre** and connection to the distribution network and hence decreases the threshold especially for single-family houses to join.
- Connection fee with **longer term of payment**. The energy company provides the customer with an opportunity to pay the connection fee as fixed monthly fees (with a low interest rate) during a longer period.
- **Separate pipe fee for the connection**. The customer pays the pipe fee according to the length and width of the pipe within their courtyard.

#### Financial support:

- **Financing:** Attracting new customers with financial support or services by the company (applied in Germany). The aim would not necessarily be to obtain profit for the company but it could serve as an instrument to support marketing. (Energy-An Consulting 2009; Rajalämpö 2005)
- **Investing support** by the government for changing a fossil fuel based heating system to district heating (applied in Germany and Sweden)

#### Other:

- **Separated production and transfer fee**
- **Using an energy fee only**, could be applied to detached houses and low-energy houses (only to a small customer group).
- Transferring a part of the **fixed costs to the energy fee** in order to motivate the customers to save energy.

Also, new intelligent metering systems with remote metering features and customers' increasing possibilities to affect their consumption habits will cause changes in energy pricing. In the future, a dynamically fixed energy price (pricing depending on timing and consumption level) will make the pricing more cost correlative and based on the market situation.

### Service models

In future, as in many other technology dominated fields, also district heating companies will change their business activities more into a service-oriented business. This trend has already been occurring and for example production, maintenance, customer service etc. are increasingly being seen as parts of a larger service unity. The mentality of the district heating companies is changing and more services need to be created in order to maintain the current market share and to attract new customers.

Customers will be more interested in energy saving and will increasingly demand energy consulting and instruction services. Customers also appreciate easiness and functionality of the heating system and therefore new services or service packages which will make joining to the district heating network easier should be provided.

Examples of new service innovations and existing (pilot tested) service models are presented below (please see more examples from the annex H)

- **“Turn-key”- solution:** The service covers the planning of the most suitable aggregate service including permissions, installation and the care and maintenance of the system. The service is suitable for customers who need to make a large decision with many details, and who do not have enough of knowledge themselves (Syvänen & Mikkonen 2011).
- **Renting the heat distribution centre and the connection to the customer** (see more details in chapter 2.2) (Energy-An Consulting 2009)
- **Financing services** (see more details in chapter 2.2) (Energy-An Consulting 2009; Rajalämpö 2005)
- **Consultation services:** Some customers are in need of better information, and therefore better instructions for different occasions or a 24-hour-open Helpdesk service would be useful (Rajalämpö 2005).
- **A package including several connections:** The customer is provided with a customized package including, in addition to district heating, several different connections, e.g. electricity, internet-, cable-TV. This model supports district heating marketing and widens the customer surface with new products but it requires that the energy company is selling also electricity or that it can co-operate with other service providers (Rajalämpö 2005).
- **“Great value” –package:** A district heating connection package, which includes special additional features, such as a few free inspection visits after 2 and 5 years. The package increases the attractiveness of district heating as a heating system (Rajalämpö 2005).
- **Green heat:** The popularity of sustainable lifestyles is increasing and environmentally friendly energy is becoming more appreciated, and hence, also district heating companies need to provide customers the possibility to buy “green heat”. The problem is that although the product is attractive to the customers, the description and pricing is more problematic than that of “green electricity”. The additional costs might be high and customers might not be willing to pay a very high additional fee (Energy-An Consulting 2009).

### Other methods and technologies

The competitiveness of district heating will be enabled by a suitable combination of cost efficiency and lighter district heating technologies. These technologies includes e.g. optimization of heath loads, cost-efficient digging methods, minimization of the investment in the founding phase, low transfer losses, cost-efficiency of small scaled production and new aggregate concepts. According to a Finnish study, by using these technologies the total investments could be decreased by 40%, and 20% savings in losses could be gained (Hagström *et al.* 2009)



Swedish studies have shown that best results in cost savings have been achieved by good planning and optimization, efficient working methods, locating the heat deliver centre next to the streets and by four-pipe systems. It has also been presented that in addition to small improvements in technologies, a favourable holistic planning, including the planning of the area and optimisation in the planning phase, ensuring the functioning of different work phases and choosing the right technologies, has even a larger impact on the costs. Also, a comprehensive partnership between the construction company and the energy company would enable the energy company to affect the solutions made already in the planning phase in order to create a reasonable and suitable area for district heating (Hagström *et al.* 2009).

Also hybrid heating systems with distributed and central production completing each other, will become more common in the future and new service models with cooperative planning by the energy company, customer and the technology supplier, will be needed. Intelligent technologies will become more common, and because of better production and storing methods as well as real time metering possibilities will enable better optimisation of the whole system and also decrease greenhouse gases (Pesola *et al.* 2011).

### **Summary of services and pricing methods in district heating in Finland**

The strengths of district heating, such as easiness and reliability, can still be used as marketing arguments in the future when trying to attract new customers, many of which are owners of low-energy buildings. In addition to this, new innovative service and pricing models focusing on real customer needs are necessary for maintaining the current market situation. Also, new technologies, such as remote metering, hybrid heating systems will become more common and they will provide new challenges but also opportunities for district heating.

High connection fee has been identified as an important barrier for the customers to choose district heating, and new pricing models could be used to reduce this problem (for example lengthening the payment time or providing an option of renting the heat distribution centre). Also, in the future the favour of sustainable lifestyles and “green heat” is expected to increase and it is necessary for district heating companies to develop their products in order to respond to the customer demand.

As in other technical fields, a transition towards a service-oriented way of thinking is taking place also in district heating companies. Providing comprehensive service packages (such as a “keys in the hand”-service, or a connection fee including the heat distribution centre and its maintenance) and focusing on different needs of different customers could be methods for district heating companies to increase the attractiveness of their products. Different consultation services will also be demanded in the future as customers often feel that information is not easily available, and also, as customers want to have a stronger control over their energy consumption habits.

Figure 19 summarises the main future trends and problems and proposes also solutions how district heating can maintain its market position in the future.

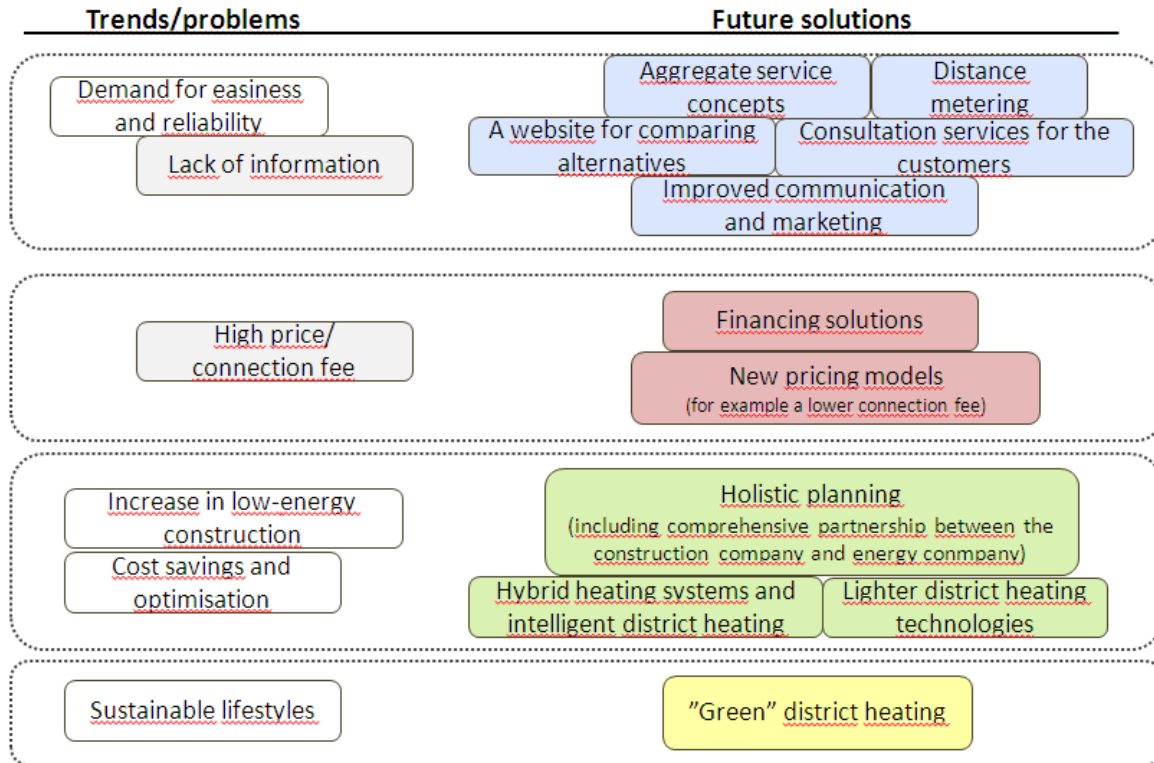


Figure 19: Main future trends, problems and solutions for district heating.

### Workshop FIN1 - case district heating

VTT organised workshop with energy companies and the focus was in services for district heating clients. The background material for the workshop was report "state-of-the-art of services and pricing principles in district heating" (in Finnish). The focus in workshop was in the following themes:

- 1) Service scope & contents
- 2) Partners and stakeholders; roles and responsibilities; value network, value chain and interactions by stakeholders
- 3) SWOT analysis; Risks, barriers, drivers and incentives; legal aspects; influence on costs and benefits

The most interesting service models based on the pre-study:

- New pricing models (e.g. transmission pricing, free-of-charge subscribe, financing services, ...)
- Information services
- Services based on remote metering
- Use guidance and energy consultancy/guidance
- Remote supervision with early warning services
- Full service concepts (heat, service, distribution, client service etc.)
- Turn-key service packages (Design, building permission, installations, service, maintenance etc.)
- Leasing of district heating connection/substation
- Supplementary services included in the package (guarantee and inspections, cooling, solar heating, hybrid systems etc.)
- Partnerships in district projects (variations in finance-design-build-operate-transfer)

Most of these services are already possible to get from district energy companies or from their co-operative companies.

**Concept: Turnkey district heating system for single family houses**

The workshop group selected one case service concept for the further analysis. This concept is **turnkey district heating system for single family houses**.

The proposed service concept includes the following items (Figure 20):

1. Heat and heat distribution for the client
2. Design support in designing heat transmission and distribution substation and house appliances using district heating
3. Support in building license application
4. Installation services
5. Supervision in construction (heating system)
6. Commissioning process in start-up of the system
7. Maintenance/service

The need for the concept is based on needs of the clients. The client would like to get all the service from one service provider. This service provider can supply all the services or coordinate the supply of parts in the concept.

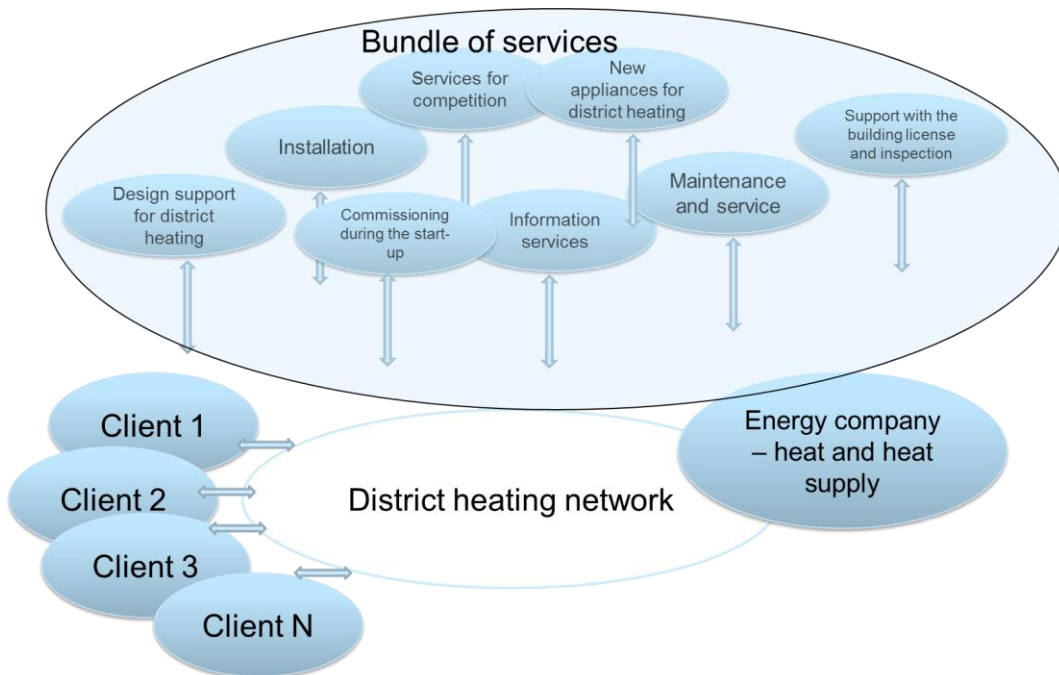


Figure 20. Bundle of services for turn-key delivery of district heating in single family houses.

The stakeholders involved in the full service was discussed but not described due to various possibilities to organise the full service.

Risks, barriers, benefits and drivers were analysed by SWOT analysis (strength, weakness, opportunities and threats). **Figure 21** presents the summary of SWOT-analysis.

<b>Strength:</b> Need for services covering the total supply exists Turnkey delivery (one stop shop) The sub-services exists but are distributed; the bundling of services would improve the accessibility/availability of the services	<b>Weakness:</b> There are few new clients for district heating from single family houses; the clients are typically regulated/steered by city plan Profit of clients in single family houses is quite small: the service concept needs to be very cost-effective to give profits for concept Sub-services already exists; the bundling of services needed
<b>Opportunities:</b> The sub-services already exists, but distributed in several suppliers Increases the amount of the clients in district heating sector. Increases the revenue of energy company	<b>Threat:</b> The sub-services have too much overlap with existing services competition legislation puts limitations for the concept

**Figure 21. SWOT for concept “Turnkey district heating system for single family houses”.**

### **Interview FIN1 – case Company One1 delivering renewable energy solutions for districts**

Finnish company One1 supplies district renewable energy solutions as a turnkey project. It focuses on developing and supplying energy concepts from the initial concept analysis to the end of the project's life cycle. One1's sales and development director, Interviewee, was interviewed in May 2012.

**One1 concentrates on B-to-B, customers**, typically energy companies, municipalities and cities as well as large construction companies. According to Interviewee, energy companies have often natural role to be an energy producer also in smaller areas, which are farther off from current energy networks. One1 aims to act as a cooperation partner of energy companies, and not as their competitor.

Main focus of One1 is to help their customers to solve their problems by providing knowledge, and supplying necessary solutions and management of projects. One1 provides both (heat) energy, but also other services in co-operation with its partners. One1 can take care of system integration, e.g. definition of systems, how energy consumption data should be sent and utilised. Integration is needed for IT and controlling systems, but also in also invoicing and reporting etc. In addition, planning of operation roles of each stakeholder is important, and the structure varies a lot in different cases, depending on the involved stakeholders and combinations, or e.g. whether the (heat) entrepreneurship is involved. Hence, flexibility is the key issue in all operation of One1.

One1 provides also **energyportal service**, which gives areal energy consumption information (which can be seen freely by everyone) and can sign in to see their own specific energy consumption data).

Energyportal gives information about:

- energy reports & information to customers (incl. heat & electricity) - energy data is got from energy companies
- used energy sources to produce energy
- weather information
- advises on energy savings and renewable energy
- other services can be ordered: cooperation partners will execute, e.g. building maintenance

Interviewee states that independent from the specific case, there is certain uniformity and same kind of challenges in every local renewable energy project. First of all, renewable energy is a broad term; lots of different technologies and knowledge is needed. Also the operation field is diverged: with different geographical locations, environment, countries, new or old district etc. Many renewable energy systems are also relatively new, only a few pilots of hybrid renewable energy systems exists, and thus courage is needed from the actors. In Finland, only pellet & bio mass boilers are quite ready in a neighbourhood

level systems, other systems are newer. Other challenges are typically: lack of resources and/or knowledge with the staff (of energy companies and municipalities); lack of financial resources; municipalities and energy companies may not want to be developers by themselves; and projects have long time scales and typically projects start slowly.

Interviewee told that **largest problem is typically financing**: Who will invest? Who does it naturally belong to? This is why new combinations and arrangements for financing are needed. Often it is difficult to calculate exact values and benefits from the finance point of view. Also courage is required in implementing new solutions.

According to Interviewee, energy itself does not raise interest, you have to include also **other services** as well to the offer. Also activation and integration of community is included. Residents are interested about what is going on in the residential area, and One1 operates together with energy companies & provides, enabling thus a broader contact area to residents.

Interviewee mentioned also, that there are different kinds of problems in areal development and implementation projects. In addition to problems of execution phase, there are also problems related to services, program development and development of operation. Moreover, broad knowledge is needed about hybrid renewable energy systems and their implementation; and broad networks of stakeholders are involved.

Interviewee states that energy architecture should be better taken into account (including also ICT systems) already in the beginning of the project and designing of city plans, which is also valid for involving end users and residents, which affect e.g. to the need of transport and services.

Interviewee has notified that currently the support politics is a bit illogical, and often municipalities do not have resources to implement the plans. He suggests that financial support should be directed more to energy companies, which are owned by municipalities. Clear addition to financial support is needed to do investments in local, areal renewable energy systems. Moreover, energy company could be the one choosing, which area will be developed, and take care of the designing of city plans, instead of a municipality doing it. However, municipality needs to be active; they could guide energy companies to do city planning, while the energy company could get sufficient financial support for the area.

### **Interview FIN2 – expert interviews**

Several interviews we performed at the early phase of the project and these were reported in (Kohonen et al, 2011). The smart energy solutions proposed by the experts is summarised in the following (note: references can be found in original document D6.6, Kohonen et al, 2011):

According to Hänninen (2011), before discussing what new services smart solutions can provide we should discuss who should develop and provide those services. As there is a division between monopoly and market activities in electricity markets, the question is with whom the end customers interact when it comes to new services. Hänninen argues that there should be a clearly defined role for monopoly actors, which in general are operating the grid so that security of supply is guaranteed and that a market place is created for suppliers and end customers. Thus the suppliers should be the ones to develop and provide new services. It is also possible that third parties become active in providing new services. For example ThereCorporation (2011) develops products and services in household automation. Unfortunately in Finland there has not been much of this kind of service development, as the price seems to be the only thing that matters for the end customers. (Hänninen, 2001)

Hänninen (2011) notes that there is currently discussion in the Nordic countries whether there should be only one interface to customers in the electricity markets. This means that the current situation, in which customers get different bills from a distribution company and an electricity supplier would be replaced by only one bill from the supplier. The supplier would then pay for distribution to the distributor, so the customer could only work with one energy company. England has this kind of model already. Hänninen thinks that one interface model could also improve market development to more service-driven competition instead of just price competition. Different suppliers would start offering new services.

Auvinen (2011) continues that their key finding is that there is demand for turnkey solutions and some kind of service integrator. End customers can't sort out all different technology providers, processes, licenses and subsidies. Thus there should be only one interface or service provider for end customer that deals with all that, and coordinates the processes with subcontractors and partners. Otherwise it is too complicated for the end customers. She notes that new service design is needed to get consumers involved and willing to pay for new technologies. Oostra (2011) also notes that facilitators might emerge to help existing businesses with their smart solution transition, by providing information about business opportunities and enhancing collaboration between different industry actors.

Suppliers must also think whether they want to participate in developing new services at all. They might fear that new services could indirectly reduce their profits by enabling customers to reduce their consumption. Koivuranta (2011) argues that there are two reasons why suppliers have to adapt to smart grids even if all of them would not want to. Firstly, at least Finnish law demands retailers to inform customers about their energy consumption. Thus regulation sets the boundary that the companies must obey. Secondly, markets will determine if there are profitable opportunities in energy efficiency. If there will be opportunities to reduce end customer energy consumption in a profitable way, there will be some other company delivering that service if retailers won't start providing it. Koivuranta notes that current retailer companies might disappear from markets altogether if they can't adapt to the new situation.

The interviewees mention a lot of different services, but most of them are mentioned in the literature as well. Hyvärinen (2011) notes that all kinds of software applications are needed to control power flows, energy storage and loads and to provide price signals and information on energy use to the different parties. Most mentioned services are targeted at customers, but especially Six (2011) discusses services for suppliers and distributors. New information could be used for supplier risk management and portfolio management so that suppliers can do their business in a more efficient way so that they might become more competitive and offer lower prices to their consumers compared to a market player who does not benefit from intelligent options. Grid-related services include voltage control, transformation load reduction, balancing services and others to manage grids in a more cost-efficient way. Six continues that there is a challenge in bringing them all together but they are important at the same time. He argues that demand side management and other grid control should take into account both the commercial objectives of reducing market price peaks and the boundaries of the grid so that load peaks would also be reduced. Also Knigge and Mulder-Pol (2011) note that DSOs and suppliers might have contradicting goals and even different actors' internal goals might be contradictory. For example Enexis has three goals. Firstly, they want to optimize grid capacity, secondly, they want local demand to be met by local sustainable production, and the third goal is to increase market participation.

Most new services are targeted at end customers. Customers can be informed of their consumption for example by displays showing real-time consumption possibly distinguishing between different home appliances. Maintenance of appliances could be done from a distance (Bongaerts, 2011). Monitoring could be possible also with mobile devices. Vattenfall already has a service that customers get a text message, if there is a blackout in their household. This is a suitable service for example for Finnish summer cottages, since many of them are located in areas that have electric lines above ground and are vulnerable to thunderstorms and falling trees. Fortum has a pilot project called Hand Held (Koivuranta, 2011). In that project around 200 test users have been given a mobile device that they can use to monitor their home energy usage. The aim is that in the future people could both monitor and control their home appliances by a real-time mobile system. There are also pilot projects where the customer interface includes information about consumption, energy prices and the type of production. Some equipment might be able to use different types of energy, for instance gas or electricity. With a smart system these devices can decide automatically which source of energy to use depending on price or convenience (Gordijn, 2011a). When customers have their own DG, the system could optimize almost real-time when it is best to use electricity from the grid and when to use own production. Hänninen (2011) argues that this development reduces the customers' dependence on the national grid and eventually we will get rid of all outages. In general, the opportunities of current IT systems will be available in energy consumption as well.

Another example of new services is demand response. If the end customer electricity price would start following market prices there could be possibilities for reduced demand when feasible. For example the supplier could agree with the end customers that their consumption will be cut automatically, if the market

price goes over a certain limit. This could be combined with outside temperature metering at consumer's premises, since of course heating can't be turned off when it is cold outside, even if there is a peak. Automation is needed, so customers don't have to pay attention to their consumption on an hourly basis, but rather agree to certain conditions and let the system optimize energy usage within the customer's preferences and without comfort loss.

Furthermore, increased information will provide possibilities for data mining. This would enable better understanding of consumption behavior and thus improved possibilities to understand customer needs. When needs are understood there is a better chance to create additional services that customers are willing to pay for. For example different customers might want to use energy at different times and certain bundles of services could be targeted at certain segments of customers. All depends on when and how the customer uses energy.

In addition smart solutions could provide charging for electric cars and possibly using them as a grid balancing method when necessary. Fortum has a project called Charge and Drive, in which they have established load points for electric cars (Koivuranta, 2011). Customers can use the electric charging point via text message. The text message identifies the customer and thus adds the electricity bill to their phone bill. The project is done together with Nokia Siemens Networks.

Hänninen (2011) argues that in general, energy sectors lack innovation capability, as it is a quite conservative field. Developers should be more innovative, create new needs and verify if different services would work. He continues that for example the text message was invented by accident and it was offered to customers just to try if it might work. And as we know, it was a huge success. Thus, energy sector needs courage to try new thing and be more innovative.

Auvinen (2011) notes that the energy sector needs innovation both in service and in product design. The problem in the new energy business is that in general there is not a huge demand for energy efficiency or saving. Energy efficiency is not an interesting or tangible issue, so it is difficult to commercialize products that people would be willing to pay for. She argues that people don't want a smart meter in itself but it has to be sold to them in some other way that really adds value to them. Even the possibility to save money doesn't seem to help in many cases, new services have to relate to other needs, such as control, security or social needs. More people from creative fields are needed to design new services and help in usability and selling. For example the British company GEO has developed smart meters with similar panels to car speed meters. This appeals to people's need to control the household economy rather than just saving money, since the panel shows how well the customers are in line with the energy and carbon budget they have set themselves. Auvinen argues that the concept has worked because it is simple and understandable. GEO works together with British Gas, because a small company couldn't produce the meters themselves in a profitable way.

Auvinen (2011) continues about another model that has worked in Japan, where smart meters are sold as complementary products with household security systems. Here again energy is not the main issue. According to Auvinen, service designers and psychologists emphasize, that product and service concepts should be simple, usable and appeal to people. Social sharing and visualization usually helps. There are models in which end customers see their consumption compared to a similar household's average and people can get small rewards if their energy consumption is less than average and they belong to group of top 10 % having lowest energy consumption (or highest energy efficiency). This has lead to an overall reduction in energy consumption. A service that seems to have demand in Finland according to market research is a platform where people could compare energy efficiency and renewable energy production options for their household. Currently people don't know of the choices they have and it is very difficult to compare for example whether one should buy LED lamps or invest in something else. The platform should not only compare the costs of different options, but also the effort and user experience.

In conclusion, it is an open question who should develop new services in the first place, but some interviewees argue that it should be the role of suppliers and third parties. Services will be created to both industry actors and end customers. Thus some services benefit suppliers and DSOs directly while others are beneficial if the customers are willing to pay for them. Industry services may include e.g. risk and portfolio management, voltage control and balancing services. End customer services include demand response with automation, remote monitoring and control, bundle of services such as broadband

connection in addition to electricity and taking care of the whole energy system rather than just electricity or heat. It is emphasized that energy is a difficult thing to sell and thus a new marketing approach and service design is needed. Energy could be associated with control, security and social sharing. In Finland there is demand for a platform where customers could compare the energy services available to them.



## Annex J Interviews Italy

In Italy bilateral interviews were conducted in order to analyze the distinctive features of six different existing energy districts:

1. Innovative energy/heating district based on geothermal source (Polo Energie Rinnovabili Ferrara)
2. Traditional district heating model based on CHP (Province of Turin)
3. Energy efficient district financed by the European Commission (Comune di Alessandria)
4. Production of energy for public buildings based on forest biomass supply chain (Borbera valley)
5. Eco-district for social housing (Quartiere San Polino, Brescia)
6. Private energy districts of Milan airports

The interviews were focused on the following themes:

- Stakeholders involved
- Administrative structure
- Services provided
- Technological features of the systems utilised in the energy district
- Business model
- Financial resources
- Operative model (operative and maintenance management)

The interviews were conducted by Paola Laiolo (ISPE), Giorgio Urbano (DAPP), Mauro Alberti and Andrea Mutti (CESTEC).

### **1) Polo Energie Rinnovabili Ferrara**

Ferrara is a city in North – Eastern Italy, covering an area of about 2.600 km<sup>2</sup>. The whole area can be defined as temperate climate with sub – continental characteristics, cold winters and warm summers and precipitations from modest to moderate but evenly distributed throughout the year.

After the energy crisis of the 70's, the Municipality of Ferrara started the 'Geothermal project', aimed at supplying the urban heating system through the exploitation of an underground source of hot water (100°C hot and approx. 2.000 m. deep).

An **Integrated Energy System** was implemented starting from November 1990, based on:

- Renewable Sources (Geothermal source);
- Recovery from industrial process plants (Waste to energy, WTE);
- Back-up thermal stations, supplied with methane gas, satisfying the demand during consumption-peaks;
- Four inertial tanks, aimed at storing the heat produced by the sources in lower demand moments.

From a **technical point of view** the Integrated Energy System was characterized in 2011 by:

- A production of about 179 GWh of thermal energy, coming from geothermal energy (41%), Waste to energy (42%), methane and oil gas boilers (17%).
- A distribution network of approx. 52 km long (length of the way in double pipes).
- About 245.000 m<sup>3</sup> of users, equal to 21.800 standard flats (22% of the overall number of apartments located in Ferrara).
- Energy savings amounting to 14.800 TOE saved.
- Avoided emissions amounting to 47,560 kg of NO<sub>x</sub>, 36,628 kg of SO<sub>2</sub>, 39,411 tons of CO<sub>2</sub>.

**Plans for the future** include the development of the existing system, by increasing the supplied volume up to 9.000.000 m<sup>3</sup> of users, covering at least the 91% of total production with renewable energy or

recovery from industrial processes. The development project, in addition to geothermal source, will include other innovative solutions such as (Figure 22):

- A Solar Thermal Plant (1 MW installed power)
- An ORC (Organic Rankine Cycle) turbine, that will produce 1 MW net active electric power

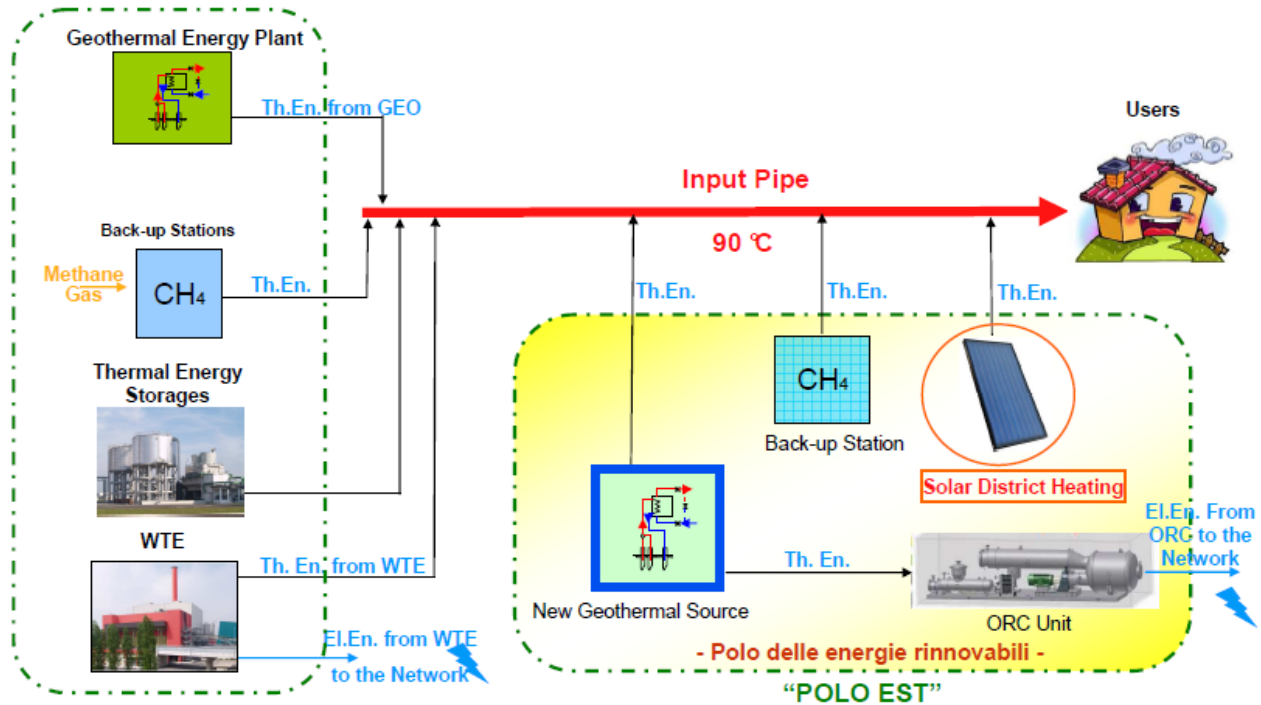


Figure 22. City of Ferrara District Heating development plan

The **main stakeholders** involved in the case of Ferrara are three:

- The City of Ferrara
- HERA S.p.A.
- Consorzio Ferrara Ricerche

As to **their role** in the process:

- The City of Ferrara launched the project by starting the exploitation of the underground source of hot water.
- HERA S.p.A., a multi-utility public-private company providing energy and environment related services, developed the Integrated Energy System and was responsible for a) construction and management of energy/heat cogeneration plants, thermal power stations and air conditioning systems b) production, transport and sale of heat for industrial and domestic use
- The Consorzio Ferrara Ricerche is a no-profit public-private research center, which has been involved in the identification of new geothermal reservoirs.

Regarding **the ownership of the Integrated Energy System**, in a first phase (realization of the geothermal plant in the 70's - 80's) it was property of the Municipality of Ferrara, while starting from the 90's it is owned by HERA S.p.A.

A **service contract between the Municipality of Ferrara and HERA S.p.A.** is in force and establishes the conditions of service. According to this contract, the heating service offered by HERA is considered of general interest (so they must respect some minimum quality requirements), but is provided at market conditions.

HERA manages **regulated services** (e.g. the integrated water cycle, urban waste, and gas and electricity distribution) and **free market services** (e.g. waste disposal and gas and electricity sales). For regulated services, the tariffs applied by Hera are regulated by controlling authorities (AEEG – Italian Authority for Electricity and Natural Gas and ATO – Water and Waste Regulatory Authorities), while for free market services tariffs are influenced by competition among companies.

**Heating tariffs** are set according to the market logic, in order to be competitive with traditional heating providers (on average HERA tries to provide a price of 5-7% lower than heating produced by methane boilers). They also take into account additional services such as:

- the maintenance of pipes and heat exchangers
- the amortization of the heat exchangers provided to the Client
- the heat meter's lease

The Table 14 shows the arithmetical average of the bills for a household resident in the municipalities covered by district heating, with average consumption of 8,630 kWh (equivalent to 1,200 m<sup>3</sup> of methane gas), with a monomial domestic tariff.

Table 14. The average district heating bills for households.

<i>The district heating bill</i>			
<b>(Euro)</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>
Meter rental	31.80	24.99	24.99
Variable quota	821.81	879.86	859.78
VAT*	100.56	107.28	105.09
<b>Total</b>	<b>954.16</b>	<b>1,012.13</b>	<b>989.86</b>

The total expense incurred by a household in 2009 was 2.2% less than that of the previous year, due to the reduction in the price of gas in 2009.

A variable automatic compensation from Euro 30 to Euro 120 based on the type of supply is foreseen for customers **in case of failure to comply with standards, for causes attributable to Hera**, such as estimation for the execution of simple works, the activation and reactivation of supply in the event of suspension due to late payment. The compensation may be increased by up to five times due to delays in fulfillment times.

Regarding the **financial sources** to develop the Integrated Energy Systems:

- in the first phase (investment to exploit the underground source of hot water) the Municipality of Ferrara benefited of a national public grant (Legge 308 Ministero Sviluppo Economico);
- in the following phases HERA S.p.A. used private own funds to develop and implement the system;
- for the future expansion plan (Solar Thermal Plant + ORC) several financing options are under consideration: private own funds + EIB loans + European Commission grants for research and demonstration projects.

Among the **main barriers** identified by HERA to further develop its services there are:

- lack of a national or regional regulation governing local district heating networks and setting a common framework for minimum service conditions<sup>1</sup>;
- lack of legislation allowing to transfer excess heat to the heating network;
- lack of end users' cultural sensitivity and awareness towards renewable energies.

A special attention is paid by HERA to the **dialogue with local communities and end users**, its reference communities, through their involvement in advisory boards and information and participation initiatives, such as guided visits to Hera plants and cooperation with local schools.

<sup>1</sup> In Italy district heating is not subject to the regulation of AEEG – Italian Authority for Electricity and Natural Gas.

Concerning the future energy networks, HERA S.p.A. considers as key drivers **smart grids** and **ICT platforms like the ones developed within E-HUB**, which would allow a more active involvement of end-users and self programming energy consumption.

However, many efforts are still needed to understand how to deliver these services in the best way to the final customers and how to 'educate' them to this new way of managing energy.

## **2) District heating Province of Turin**

In 1980 a "*Strategic plan for the development of the cogeneration and the district heating in Torino*" was jointly established, coherently with the strategic plans of Piedmont Region and Torino's Provincial Administration, and with the technical collaboration of Politecnico di Torino and ENEA (National Agency for Energy and new technologies).

During these 30 years, the biggest district heating system in Italy was designed and built in Turin. It is able to heat 54 million m<sup>3</sup> of buildings corresponding to a population of 560.000 inhabitants.

Regarding the **technological features**, the system currently includes:

- *Le Vallette district*

In 1982 a CHP plant with diesel generators was created. This plant was then modernized in 1992 with a post-combustion system. Now this plant gives heat to about 3.000.000 m<sup>3</sup> (heated volume) and 30.000 inhabitants of the district.

- *Mirafiori Nord district*

In 1988 a CHP plant was built reaching an area of 2.250.000 m<sup>3</sup> (heated volume) and 20.000 inhabitants.

- *Torino Sud district*

The Torino Sud district heating network was put in service in 1994 and reached 27.000.000 m<sup>3</sup> (heated volume) and 270.000 inhabitants.

In 1999 this district network was connected directly to the Torino Sud DH network and they are now an integrated system, including two integration and storage plants (HOB).

- *Torino Centro district*

In 2001, a further expansion of the heating and gas network was implemented, in order to provide district heating in two additional districts of Torino: "Torino Centro" and "Spina 3" (44.000.000 m<sup>3</sup> of heated volume). A new CHP Plant was built in Moncalieri and a new district heating network with heat exchange substations was developed, as well as a new integration and storage HOB plant in order to reach the target of 36.000.000 m<sup>3</sup> (heated volume) and 360.000 inhabitants.

- *Torino Nord district*

In 2006, due to the ageing of Vallette CHP Plant, a further expansion of the district heating system was planned. It included the construction of a new DH network and a new CHP Plant fed by natural gas in the northern area of the city, reaching 54.000.000 m<sup>3</sup> (heated volume).

The electrical Energy cogenerated from the plants connected to the district heating network, during 2010, was 3.900 GWh. The thermal Energy in the network, in 2010, was 1.700 GWh, and about the 90% was made with high efficiency CHP plants.

**Plans for the future** include an expansion of the district heating system to the metropolitan areas surrounding the city of Torino. The final objective is the development of an Integrated System serving the Torino's metropolitan area able to provide about 84.000.000 m<sup>3</sup> of heated volume (equal to 840.000 inhabitants) with a CHP high efficiency heat production and more than 80% of the needed thermal heat.

The **main stakeholders** involved in the case of Torino are the following:

- The City of Torino
- The Province of Torino
- Piedmont Region
- IREN Group
- AES Torino S.p.A.
- Politecnico di Torino

As to **their role** in the process:

- The City of Torino, the Province of Torino and Piedmont Region were actively involved since the 80's in the strategic planning for the development of cogeneration and district heating in Turin, as well as in the process of legal authorization for the construction of the new CHP plants.
- IREN Group, the 2nd multi-utility Italian group and the 1st one as far as district heating is concerned, through its parents companies IREN Energia S.p.A. and IREN Mercato S.p.A, designed and built the district heating system in Turin and commercializes gas and heating.
- AES Torino S.p.A., born from the joint venture of AEM Torino (nowadays IREN Group) and ITALGAS S.p.A., has as main activities the natural gas and heating distribution and transportation and the operation & management of the district heating network.
- Politecnico di Torino was involved in the designing and feasibility study phase.

The close cooperation among these stakeholders has been a distinctive feature in the case of Torino: the strategic planning of the system was jointly defined since the beginning and an agreement with the gas distribution Company for a synergic plan in developing the district heating system was established. Also for the future expansion project a permanent working group involving institutional public entities and private energy/gas operators will be put in place.

Regarding **the ownership of the district heating system**, the CHP and HOB plants belong to IREN Group, whilst the district heating network is owned by AES S.p.A...

About **the services offered**, IREN Group has four main business areas:

- Electrical energy segment: electricity generation, transmission, distribution and sales.
- Heating, gas and district heating segment: gas distribution, heat production and sales, district heating services.
- Services segment: street lighting maintenance, traffic light system management, municipal electrical and heating system management.
- Telecommunications business segment: provision of fixed network services, broadband network services and Internet services.

As to the **regulation of the district heating services**, in Italy an ad hoc Authority has not yet been created. A Piedmont regional law (Legge regionale 28 maggio 2007, n.13) establishes that new buildings and thermal retrofitted buildings must be equipped with a centralized sanitary hot water and heating production plant, as well as with automatic temperature control systems. These typologies of buildings have also the obligation of pre-arrange the connection to the district heating system (even if they are not formally obliged to sign a contract with IREN Group).

Concerning the **financial sources** to develop the district heating project, it was financed both through IREN Group own funds and through EIB financing and national public funds.

According to the interviewee, looking at the future a key issue will be to develop **the district cooling**, which would allow to use heat also during the summer (via absorption chillers technology). Until now this kind of service has not yet been widely exploited, but it could represent a strategic area where to invest. Moreover, a close collaboration between Iren Group and Politecnico di Torino has been established in order to develop research projects in the field of '**Smart Thermal Grids**'.

### **3) Energy efficient district financed by the European Commission (Comune di Alessandria)**

The municipality of Alessandria is involved in a European Union funded project called Concerto Al Piano, funded in the framework of FP6. The project started on 1st September 2007 and will close on 31st December 2013.

This district was selected since it could have some contact point with the Project E-HUB. This starting point could be utilized as a basis for the development of the E-HUB business model.

Alessandria is a 100,000 inhabitants city, in North West of Italy. AL Piano building program has already the basic financing for building construction and infrastructure innovation (social and economical actions



included) and it can be considered as an urban pilot project at the neighbourhood level. In the same district the City of Alessandria has already developed the Photovoltaic Village, inaugurated on November 2005, which won the 1st prize of the 2003 Sustainable Cities Award promoted by the Italian Ministry for Environment.

The more comprehensive approach of Concerto AL Piano (Figure 23) includes:

- eco-refurbishment of existing social dwellings (299 dwgs)
- new eco-village (101 dwgs) and elderly house (50 dwgs)
- health centre (sport, swimming, gym)
- diffuse energy retrofit for the buildings of the district: plan to develop energy audits for 3000 dwellings and to supply resources for energy/building retrofit of 600 dwellings of the district
- measures for green and infrastructure improvements.

(Ref: [http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ\\_RCN=9902138](http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=9902138))



Figure 23. South Alessandria, Concerto AL-piano

Currently in the European Project “Concerto AL-piano” the **involved stakeholders are**:

- DHV (Netherlands)
- Fundacao Gomes Teixeira da Universidade do PORTO(Portugal)
- Geonardo Environmental Technol. (Hungary)
- ATC – Agenzia Territoriale per la casa della Provincia di Alessandria (Local Agency for public dwellings in the Province of Alessandria);
- Impresa “GEOS GREEN s.r.l.” (construction company);
- Impresa “MUTTI COSTRUZIONI DUE s.r.l.” (construction company);
- Impresa “Capra s.p.a.” (construction company);

- Impresa “DEGIOCASE s.r.l.”;
- Soc. Cooperativa “VERBENA a.r.l.” (construction company);
- HEAT&POWER s.r.l (ESCo)
- Softech Energia (Engineering and Design company)

Considering that within two years this district will be operative, the stakeholders will be:

- Municipality of Alessandria and ATC
- HEAT&POWER s.r.l (ESCo)
- The owners of apartments

#### **The administrative structure:**

Two dedicated agreements were signed between:

1. Municipality of Alessandria and HEAT&POWER, the so called “Convenzione energetica” (Energetic Agreement), stating the relationship and the duties of Heat&Power and other Partners;
2. Municipality of Alessandria and private/public Partners, the so called “Convenzione urbanistica-edilizia” (urban-construction agreement), stating among others the selling price of the dwellings of “Edilizia Residenziale Pubblica” (Public Dwellings) and the relevant fee.

#### **Technological features** of the systems utilised in the energy district:

- Energy efficiency: wood fiber insulation, thermal break windows with triple glazing, passive solar greenhouses, thermostatic valves, mechanical ventilation;
- Renewable sources: connection to the district heating network connected to the central biomass tri-generation, photovoltaic systems provided for the production of electricity and positioned on the roofs or any kind of sheds;
- Lighting: high efficiency artificial lighting ( internal and external);
- Central tri-generation: cogeneration fuelled with vegetable oil and wood biomass boiler.

The main **services provided** are district heating and energy supply. The goal is to do away with traditional fossil energy resources production, utilizing biomass-fueled integrated energy supply with the application of new technologies and use of renewable energies such as photovoltaic systems, solar-thermal, tri-generation, passive greenhouses, insulation, etc...

In order to achieve this goal, the planned action list is described below:

- Energy audit of 3,000 dwellings by quarter;
- Reorganization energy of 48,000 square meters surface;
- Refurbishing of 299 dwellings of “ATC” (Local Agency for public dwellings in the Province of Alessandria);
- Improved energy performance in new eco building village (No. 104 homes with innovative design with microclimate, through solar greenhouses, manifolds, etc ...;
- Improved energy performance in the construction of 41 new dwellings for elder people and No. 12 dwellings subsidized by “ ATC” (Local Agency for public dwellings in the Province of Alessandria);
- Improved energy performance in the construction of public facility with pool and spa;
- Improved energy performance in the construction of a nursery;
- Integrated energy supply with central district based on tri-generation (cooling + heating + electricity) and biomass-powered rather than natural gas;
- High level of insulation of new buildings;
- Widespread application of photovoltaic systems on all new interventions and the power of electric bicycles;
- Use of rainwater for irrigation;
- Ecological ‘islands’ (concealed underground for new homes).

#### **Business model**

Once the district will be completed and operative, HEAT&POWER, which owns the heat generation system, will supply the private owners of dwellings with thermal heat.

Municipality of Alessandria is the owner of the district heating infrastructure and it was in charge to define the “rules” between the energy producer and the private owners (end users) and the thermal energy price in compliance with the “Convenzione energetica” (Energy Agreement).

In details, end-users while buying the dwelling are bounded to pay thermal energy to the energy producer that sells the heating service, having in charge the fuel management, the operative and maintenance costs of the thermal grid and the heat generation units.

### **Financial resources**

The Project “Concerto AL-piano” is co-funded by European Commission. The Municipality of Alessandria covered more than half of the overall budget of the project (i.e. 8,5 M€).

Other activities in the same area have been funded by the Italian Government and Piedmont Region Government. For the construction of the nursery, spa and public pool Project Financing was applied.

### **Operational model (operations and maintenance management)**

The District Heating is managed and maintained by HEAT&POWER. HEAT&POWER owns the thermal and power generation system. The Municipality owns the district heating grid.

The dwelling owners buy the heating service from HEAT&POWER. The Municipality built the legislative frame (Energetic agreement) where the price, duties and rights of the service are set.

### **4) Biomass district heating in Valborbera (Italy)**

The interview was conducted with an executive of FOR-EST, the private company that manages four thermal network fuelled with biomass collected in the rural areas of Borbera Valley (South East of Piedmont),

In 2000 the Borbera valley Mountain Community decided to contribute to sustain local economy through the wood-energy chain, by installing biomass boilers fed with local forestry, parks and gardens maintenance residues, sawmills residues and providing the heat produced to some municipalities.





Figure 24. **Arquata, Serravalle and Municipio of Rocchetta Ligure.**

The Borbera Valley include the towns of Serravalle Scrivia, Arquata Scrivia and Rocchetta (Figure 24). Serravalle and Arquata are about 5 km far, while Rocchetta is about 10 km far from Arquata. This area is quite close to Genova (45 minutes by car), surrounded by extensive areas covered with forest.

The **main stakeholders involved** are:

- “Comunità Montana” (local authority with responsibility of forest management)
- Three different municipalities: Serravalle Scrivia, Arquata Scrivia and Rocchetta (they are both co-founders and end-users)
- BEA srl Val Borbera Energia e Ambiente, a public/private company dealing with management and collection of biomass
- The forest owners who are members of FOREST Cooperative (they may/may not allow to collect the biomass)

**Technological features of the systems utilised in the energy district:**

Three plants were built in 2002: Arquata (1 MWth), Rocchetta (100 kWth) and FOR-EST Headquarter (50 kWth). In 2004 a fourth biomass plant located at Serravalle Scrivia (1 MWth) started to deliver heat.

The biomass is currently collected from three main sources:

1. Wood shaving (shaved and chipped)
2. Green maintenance (trees in the towns)
3. First waste from sawmill

The biomass consumed per year is about 4000 m<sup>3</sup> of biomass, about 1200 ton/year, collected in 6 months per year. Two or three people are involved in the biomass collection activity.

### **The administrative structure**

In the year 2000 a public/private company (BEA srl Val Borbera Energia e Ambiente) aimed to manage both the biomass boilers and the fuel supply chain was constituted. BEA srl has like shareholders the “Comunità Montana”, the municipalities involved in the project and FOREST Cooperative.

The private/public company manages the 4 biomass thermal energy production plants. The municipalities of Arquata and Serravalle own the district heating distribution grid.

Currently, BEA srl has the responsibility of managing on behalf of the municipalities the boilers and is fulfilling this duty by signing annual contracts with its private partner, FOREST Cooperative. The contracts include ordinary maintenance of the boilers and fuel supply. The service is paid per kWh provided to heat users.

The agreements between FOREST Cooperative and biomass sub-suppliers are generally based on a payment per volume, in order to simplify the procedures.

**The main service provided** is district heating. The goal is to provide thermal energy from renewable sources (biomass) in an economic way, providing a full “thermal service” compared to selling of m<sup>3</sup> of natural gas, excluding the operational and maintenance service of the thermal systems.

### **Business model**

The municipalities are part of the private/public consortium as co-founders, but are Clients too. In fact, the main end-users of the district heating are 2 school buildings and 1 public building in Arquata, and 4 public buildings in Serravalle. The municipalities are also owners of the district heating network.

The municipalities can make agreements or service contracts for the management of the biomass production plants and the district heating network with private companies. The contract can last from one to three years, and it could be a public tender or a direct contract. The contract/agreement can foresee guarantees for the end-user, mainly to ensure continuity in the heating service.

The thermal energy price level is the main driver of the business, with the natural gas as a top benchmark. The price policy is to remain 15-20% less than the price of natural gas.

The tariff includes the biomass plant management, day by day operations and the biomass cost.

The users pay yearly electrical consumptions of the electrical engines and instruments for the biomass thermal station (about 3000 €/year).

### **Financial resources**

Arquata and Serravalle biomass plants were funded via European Structural funds (“Obiettivo 5b”), covering about 90% of the installation costs (this high percentage was possible since public buildings were the target of the initiative). The installation costs amounted to around 250.000 € for Arquata plant and to around 300.000 € for Serravalle.

The lifecycle of the biomass plants is about 20 years, and they do not have high maintenance costs.

Any further investment on the plants is under responsibility of the Municipalities involved.

### **Considerations about possible legislative improvements**

Even if the business model has proved to be profitable, a further expansion of the system to other Municipalities at the moment is not foreseen. This is due to the high fragmentation of the forest property and to the fact that forest owners are not always collaborative or interested in the biomass business.

A possible solution could be a wide forest-consortium, aggregating different owners and a third party (like an ESCO) that manages the forest and redistribute the revenues from selling the biomass to the heating

plants. To implement such a consortium on a large scale, it would be essential a long-term commitment by local authorities.

### **5) Eco-district San Polino (Brescia)**

Brescia is a city in Lombardy, having a population of 191.6182. The metropolitan area has about 500.000 inhabitants. The municipality covers an area of 90,68 km<sup>2</sup> and has a population density of 2.113 inhabitants per km<sup>2</sup>.

In 2004 the municipality of Brescia promoted, by means of an open call for bids, the realisation of a new district in the north-east area of its territory, San Polino, where 1.900 dwellings have been built, in addition to 28.000 m<sup>2</sup> of buildings designed for tertiary services, all characterised by high energy performance. On the whole, the value of the district has been estimated in 126 million euro.

The district (Figure 25) consists of 5 different sections, all situated along the subway, which is expected to be brought into service in 2013.

Data reported in this document refer to section (*comparto*) 15, Figure 26.

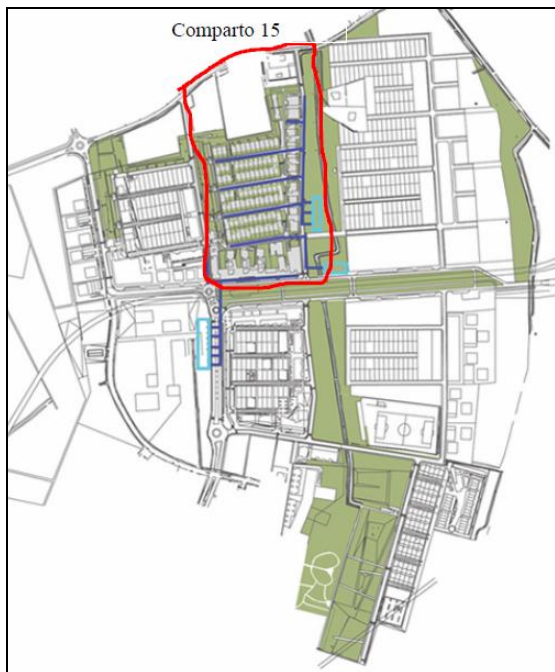


Figure 25. District general plan.

This consists of:

- 1 multi-family building block with 191 dwellings, 1 gym, 1 auditorium and 4.500 m<sup>2</sup> of commercial areas;
- 3 multifamily residential buildings with 82 dwellings, 2 day-care centres and 480 m<sup>2</sup> of commercial areas;
- 96 single family detached houses.

<sup>2</sup> According to official national statistics (ISTAT), foreign inhabitants were 36.884 (20% of total population) at 31/12/2010.



Figure 26. **Comparto 15.**

### Stakeholders

- Municipality of Brescia
- Consorzio Eco 15, whose shareholders are:
  - o Housing Cooperatives: Coop Casa Scpa di Brescia, Cooperativa Unitaria Scarl di Carpenedolo (BS), Hinterland Brescia Scpa di Brescia;
  - o Building Cooperatives: Unieco Scarl di Reggio Emilia
  - o Construction companies: Paterlini e Tonolini Spa di Brescia, Gruppo Sandrini Srl di Gussago (BS).

### Administrative structure

The district sub-section is administered and managed in a traditional way: all multi-family buildings have a property manager; services to single-family houses are in charge to owners.

### Main services provided

- water;
- heating;
- sanitary hot water;
- electricity.

### Business model

Customers are the buildings private owners and/or property managers in case of multi-family buildings, without any intermediate service providers.



Serviced provided are listed in the table below.

Electricity	Buildings have been integrated with photovoltaic panels to generate power for use by families in single-family houses or for common areas power demand in multi-family buildings. Net metering <sup>3</sup> (only for common areas uses, in case of multi-family buildings) + distribution grid power purchasing (A2A utility is the distributor, while power can be purchased by any supplier operating in the Italian market)
Heating and sanitary hot water	District-heating, supplied by A2A by means of a district sub-station and then several heat exchangers, at house level (for single-family houses) or at dwelling level (for multi-family buildings, see <b>Fig. 4</b> ), billing based on the metering of actually supplied (exchanged) heat.
Water	Dual water supply network: drinking water for domestic uses; water for public and private gardens irrigation and for WCs.

### Technological features of the systems utilised in the energy district

In the design phase, buildings orientation was constrained by the zone plan. Thus, the location of rooms has been conceived to have living rooms, with large windows, facing south-east and south-west and bedrooms and service rooms facing north-east and north-west, with smaller windows (Figure 27). Broad galleries along the sun-exposed sides of the buildings allow reducing summer heat load. All dwellings (with the exception of a few two-roomed flats) have windows on both sides of the building in order to foster summer cooling by means of natural ventilation during the night.



Figure 27. South façade of the building.

As regards the building envelope, energy performances were defined in the open call for bids:

Exterior wall: Tile blocks and insulation layer based on mineral wool (80 mm), thermal transmittance (U-value) being 0,37 W/m<sup>2</sup>K, phase shift (indicator of thermal inertia) being 7.8 hours and resulting in reduced thermal bridges.

Window and door frames: Wood-based, low-emissivity double-glazing unit with stratified glass to improve overall acoustic performance (acoustic insulation is 42 dB), Uvalue 2,3 w/m<sup>2</sup>K.

<sup>3</sup> Net metering service (scambio sul posto) is activated at the request of interested parties. Under the service, the electricity generated by a consumer/producer in an eligible on-site plant and injected into the grid can be used to offset the electricity withdrawn from the grid. GSE (the state-owned company which promotes and supports renewable energy sources in Italy) pays a contribution to the customer based on injections and withdrawals of electricity in a given calendar year and on their respective market values.

Roof: 100 mm insulation, thermal transmittance (U-value) being  $0,34 \text{ W/m}^2\text{K}$ , phase shift being 9.7 hours. As regards technical building systems, the district is connected to Brescia urban district-heating grid. There is a substation which controls the outgoing temperature to the radiators heating systems and heat exchangers for the generation of sanitary hot water. All heating radiators have built-in thermostatically

All dwellings have controlled mechanical ventilation with cross flow exchangers for heat recovery (efficiency > 60%). In the case of multi-family buildings there is one device per staircase (semi-central ventilation).

Buildings are not connected to the gas grid. Each dwelling has induction cooking systems.

In Brescia, connection to the district heating is mandatory for new buildings in areas near existing grids. Thus, it is not possible to choose alternative systems for thermal uses (e.g. geothermal or solar thermal).

In the district, buildings have been designed so as to make wide use of **renewable energy sources**. All *single-family detached* and *semi-detached houses* have thermal solar collectors (Figure 28) installed for production of sanitary hot water (2.000 kWh/year per plant) and photovoltaic panels (1,2 kWp), with net metering agreements.



Figure 28. Solar thermal collectors in district.

Energy consumption in single-family houses are notably lower, as may be seen in Figure 29 .

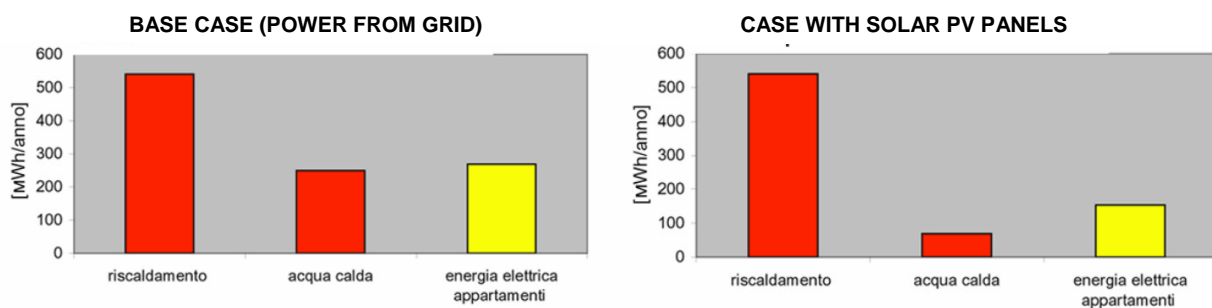


Figure 29. Energy balance for single family houses.



Figure 30. Orientation of staircases.

Solar PV panels were installed on multi-family blocks and buildings (before the launch of Conto Energia<sup>4</sup> incentives scheme) and connected to power distribution grid with a net metering contract, total installed capacity being 170 kWp to partly meet common building services demand (lifts, circulator pumps, lighting, extraction towers for controlled mechanical ventilation). Average yield of PV panels is 1.100/1.200 kWh per kWp, thanks to an effective architectural integration and optimal orientation of PV modules obtained by means of the design of the staircases covering (Figure 30).

Data for the multi-family block (191 dwellings; 100 kWp installed capacity) are reported in the Table 15.

Table 15. Energy consumption of the buildings.

<b>Staircase</b>	<b>Energy generated [kWh]</b>	<b>Energy sold to the grid [kWh]</b>	<b>Energy bought from the grid [kWh]</b>
<b>A</b>	<b>24.002</b>	<b>13.130</b>	<b>22.414</b>
<b>B</b>	<b>13.604</b>	<b>5.340</b>	<b>19.464</b>
<b>C - D</b>	<b>13.287</b>	<b>4.739</b>	<b>20.107</b>
<b>E - F</b>	<b>13.577</b>	<b>4.917</b>	<b>20.488</b>
<b>G - H</b>	<b>13.417</b>	<b>4.739</b>	<b>20.107</b>
<b>Underground -1</b>	<b>20.000</b>	<b>4.562</b>	<b>44.533</b>
<b>Underground -2 / -3</b>	<b>20.962</b>	<b>2.884</b>	<b>62.247</b>

Buildings in Section (Comparto) 15 have been certified, as regards energy performance, and would be in class C (that is a good results considering that they were built before the entry into force of the regulations at regional level on energy performance of buildings).

### Financing sources

The Municipality of Brescia issued a public call for bids in 2004 for the realization of San Polino district, defining the requirements in terms of services, technical systems and energy performance of buildings. The Municipality demanded a 20% reduction with respect to existing requirements.

<sup>4</sup> The feed-in premium scheme ("Conto Energia") provides support for both photovoltaic solar sources (over a period of 20 years) and thermodynamic solar ones..

For *Comparto 15*, the Municipality signed an agreement with *Consorzio Eco 15* to sell the property (31.130 m<sup>2</sup>) at a price of 6.335.357 €.

In the agreement the maximum prices for the sale of houses/dwellings were defined:

- 1.372 € / m<sup>2</sup> for single-family houses;
- 1.266 € / m<sup>2</sup> for multi-family residential buildings ;
- 1.111 € / m<sup>2</sup> for the multi-family block.

### **Operational model (operations and maintenance management)**

Management of services and maintenance is carried out in a traditional way, that is utility A2A has a responsibility up to the district-heating sub-station; after the substation the plants are managed by owners and / or property managers (for multi-family buildings) which may stipulate contracts with maintenance service companies or engineers<sup>5</sup>.

### **6) Milan airports - Energy districts**

In 1992 SEA SpA, along with 10 other industrial partners, constituted the company Malpensa Energia SpA, whose business purpose was constructing and operating energy production facilities of Milan airports.

In 1994 SEA SpA acquired all the company shares. It then sold, in 1995, 49% to AEM (Milan energy utility; now A2A) with which, in the same year, it signed the sub-concession agreement for the construction and management of the cogeneration plant at Malpensa 2000.

In 1996 Malpensa Energia began the first phase of plant construction.

In 1998 the realisation was completed simultaneously with the entry into service of the new Malpensa airport whose energy demand was immediately met (October 25, 1998).

In March 2009, A2A sold to SEA SpA its capital shares. Shares of SEA in Malpensa Energia went, therefore, from 51% to 100%.

In May 2011 *Malpensa Energia* changed its name to become *SEA Energia*.

*SEA Energia* designs, builds and operates combined heat and power plants for the generation, supply and sale of electricity and heat.

In particular, it has a license for the management of cogeneration plants at the airports of Milan Malpensa 1 and 2 and Milan Linate.

### **Stakeholders**

- SEA S.p.A. (and Municipality of Milano)
- A2A S.p.A.
- Municipalities / other users (nearby the airports)
- Other potential customers for energy supply by *SEA Energia* (e.g. shipping and other service companies)

### **Administrative structure**

*SEA Energia* is a services company that operates on an exclusive basis for a major customer (SEA SpA), for which it produces electricity, heat and cooling. It is also granted the possibility to sell energy to third parties.

### **Main services provided**

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<sup>5</sup> The person responsible for operation and maintenance is generally the occupier housing, is of any capacity (eg owner, tenant, borrower, lessee). The occupant of the property may transfer the responsibility for operation and maintenance of the system to an operator responsible for carrying out checks, who takes the role of the Third Officer. The person responsible for operation and maintenance of the system (the owner, occupant, manager, third party) is obliged to do the inspection and maintenance, by a regular member of the Chamber of Commerce and certificated under the DM 37/08, the intervals provided by the All. L to D. Decree 311/06.

For systems up to 349,9 kW, in the absence of specific predictions, the performance tests on energy systems must be performed at least once a year, usually at the beginning of the heating season. In the absence of specific predictions, the energy efficiency checks must be performed for systems with power  $\geq 350$  kW, twice a year, usually at the beginning and middle of the heating period.



- The plant at Malpensa produces electricity, heat and chilled water: the electricity is partially sold through the national grid, while heat and chilled water are used inside the terminal, to meet energy demand of the large airport structures (especially the passenger terminals and Cargo City<sup>6</sup>) and of other private users nearby the airport (e.g. Sheraton Hotel, "Vollandia" Park and Museum, etc.) by optimizing the exploitation of the flexibility of the trigeneration plant.
- The plant at Linate provides heating and electricity to Milano Linate. For a number of years now, the district heating system serving the airport has been flanked by another providing heat to a wide urban area in the east side of Milan (an extensive area delimited by Via Salomone, Via Ungheria, Via Forlanini, Via Mecenate and Via Fantoli).  
SEA Energia sells the heat to A2A, the company which manages district-heating grids and services throughout Milan.

### Technological features of the systems utilised in the energy district

#### a) Linate

The plant consists mainly of three cogeneration systems and auxiliary systems. The equipments ensure a continuous service for about 8000 hours / year. The prime mover of each cogeneration unit is a reciprocating internal combustion engine with net electric power of approximately 8000 kW, powered by natural gas for combined heat and power (WARTSILA 20V34SG).

Thermal energy is produced by a heat recovery system from engines exhaust gases, in the form of superheated water (about 150 °C on delivery and 90 °C on return) and by engines cooling fluids. The total thermal power, recovered from the exhaust gases, is about 18 MWt, to which it is added the recovery power from the cooling fluid, in the form of hot water (about 70 °C on delivery and 55 °C on return), for additional 6 MWt.

Besides heat recovery from engines, 2 supplementary BONO BOILERS have been installed, for the production of superheated water with power output equal to about 30 MWt each.

A thermal storage system capacity of 10 MWt allows a flexible and cost-effective heat cogeneration.

Furthermore, to comply with emissions regulations, the control unit is equipped with an SCR system (selective catalytic reduction) for the control of nitrogen oxides.

Table 16. LINATE - SUMMARY TABLE OF MAIN INSTALLED SYSTEMS

N° 3	NATURAL GAS-FUELLED ENGINES	8	MWE ea.
N° 3	SIMPLE ENGINE EXHAUST RECOVERY SYSTEMS	8	Mwt ea.
N° 2	CONVENTIONAL NATURAL GAS-FIRED BOILERS FOR SUPERHEATED WATER PRODUCTION	30	Mwt ea.
N° 2	THERMAL ENERGY STORAGE RESERVOIRS, 200 m³	5	Mwt ea.
N° 2	STEP-UP TRANSFORMERS 15-23 KV	15	MVA

#### AUXILIARY SYSTEMS:

Fire fighting system, superheated water distribution system, LV and MV electrical panels, compressed air system, natural gas decompression system.

OVERALL INSTALLED ELECTRICAL POWER	24	Mwe
OVERALL INSTALLED THERMAL POWER	84	Mwt

<sup>6</sup> Over 3.000.000 of m³ of buildings.

**b) Malpensa**

The current plant configuration includes:

- combined cycle 1: a 25 MWe gas turbine (TG3), and a 5 MWe steam turbine in backpressure (TV4);
- combined cycle 2: a 30 MWe gas turbine (TGD) and a 10 MW condensing steam turbine (TV5);
- a 10 MWe gas turbine (TGA).

The exhaust gases of the TGD can be sent, depending on energy demands, to two 16 MWt (each) simple (recovery only) boilers (in case of higher heat requirement) or to a steam generator (GVR2) for additional power generation through the 10 MW condensing steam turbine (TV5; in case of higher power demand).

Production of superheated water is done in the GVR2, for additional 3 MW thermal production.

Another vapour generator is coupled to TG3, producing 30 MWt thermal power and 30 MW electrical power "in a combined cycle".

The exhaust gases of TGA are conveyed to the recovery boiler with 16 MWt a thermal output. A 22 MWt conventional methane auxiliary boiler (CB50) is also installed in the thermal section. The total thermal power of the unit is therefore 87 MW, while the electric power is 80 MW.

SEA Energia has also adopted a distributed architecture (DCS) system for the automation and supervision of the cogeneration plant to achieve greater operational flexibility, to eliminate manual intervention during the normal conduct and manage the plant with a limited internal staff.

The plant unit is connected to the new terminal by a large driveway underground tunnel, 2 km long, which physically allows the flow of energy carriers.

*Cooling water circuit*

The group currently includes eleven towers used to dissipate the heat produced by the three main circuits (absorbers condensation, Rolls Royce cycle auxiliary services cooling, turbovapour TOSI condenser and combined cycle auxiliary services cooling)

- seven towers are induced-draught wet condensing systems, with closed circuit and abatement of vapour plume by means of superheated water (on two of the seven towers). Each tower is formed by six fans that ensure extreme flexibility.
- the most recent four towers, which have replaced one of the towers of the original system, are counterflow induced draught towers and are equipped with a system for abating the plume that uses the same water of the circuit, and not superheated water, to heat the saturated air coming from the towers. Each tower consists of 4 modules with 4 fans each.

*Groups producing chilled water*

In the refrigeration unit there are nice chillers, based on 4.5 MWf superheated water single-stage absorbers. The total capacity is thus over 40 MWf.

Table 17. **MALPENSA - SUMMARY TABLE OF MAIN INSTALLED SYSTEMS**

N° 1	SOLAR MARS100 GAS TURBINE	10	Mwe
N° 1	ROLLS ROYCE RB 211 GAS TURBINE	25	Mwe
N° 1	ROLLS ROYCE RB 211T GAS TURBINE	30	Mwe
N° 1	SICES HEAT-RECOVERY BOILER FOR STEAM PRODUCTION	41.5 450 46	Ton/h °C bar
N° 1	STF HEAT-RECOVERY BOILER FOR STEAM PRODUCTION	37 450 42	Ton/h °C bar
N° 1	NUOVO PIGNONE STEAM TURBINE	5	Mwe
N° 1	FRANCO TOSI STEAM TURBINE	10	Mwe
N° 2	SIMPLE BONO HEAT-RECOVERY BOILERS	16	Mwt ea.
N° 1	BONO NATURAL GAS/DIESEL AUXILIARY BOILER	22	Mwt ea.
N° 8	ABSORPTION CHILLERS	4.5	Mwf ea.
N° 4	THERMAL ENERGY STORAGE RESERVOIRS	200	m³ ea.
N° 3	TRANSFORMERS 15 KV-132KV	32-40	MVA

**AUXILIARY SYSTEMS:**

Fire fighting system, superheated water distribution system, LV and MV electrical panels, compressed air system, natural gas decompression system.

OVERALL INSTALLED ELECTRICAL POWER	80	Mwe
OVERALL INSTALLED HEATING POWER	98	Mwt
OVERALL INSTALLED COOLING POWER	36	Mwf

**Business model**

As mentioned, the business model is based on a private law subject (a service company, whose activity purpose is in constructing and operating energy production facilities) that operates on an exclusive basis for a major customer (SEA - Airport Company Exercises ), for which it produces electricity, heat and cooling.

It also has the ability to sell the energy produced to third parties. It, thus, makes commercial offers for the supply of heat (typically based on the avoided cost of fuel) to various parties (industry and services) operating nearby the airports, especially those that are located along lines of development of district heating grids and thus could be easily connected.

In this sense, a greater impulse to connections for private entities that are nearby, from the government side, requiring connection to the network provided that certain heat price conditions are guaranteed, could certainly encourage the maximisation of heat recovery and use.

### Financial resources

*SEA Energia* Company was established by SEA SpA (the Company that manages Milan airport businesses) along with other industrial partners.

Financing arrangements are typical of private parties.

The capital of *SEA Energia* is now 100% owned by SEA SpA<sup>7,8</sup>.

### Operational model (operations and maintenance management)

Advanced technology and operating strategy allow the generating plants to be operated by in-house staff whose sole responsibility is to guarantee optimal control of the production process. The continuous-cycle production cycle is entrusted to highly specialised technicians - 12 at Malpensa and 6 at Linate - working round the clock under a technical director who also has responsibility for administrative functions and technical support.

Besides, a responsible of technical services coordinates all outsourced activities, such as maintenance and technical controls. At Linate there is also a service coordinator. The responsibility of the operating unit is assigned to an officer, with secretary staff, which works closely with the board of directors.

#### COMPANY GENERAL ORGANIZATION



The Company maintenance policy is defined by a "MAINTENANCE SCHEDULE" plan implemented by outside contractors, which usually are the same manufacturers of the equipment, under the supervision of specialists who take care of all safety issues. This operating configuration has allowed, over the years, to achieve and maintain high reliability performances with excellent results, both economic and functional.

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<sup>7</sup> SEA shareholders are:

**Public shareholders** (70,21%): 14 bodies/companies; Comune di Milano 54,81%; ASAM 14,56%; Provincia di Varese 0,64%; Comune di Busto Arsizio 0,06%; Altri azionisti pubblici 0,14%

**Private shareholders** (29,79%): 524 companies/funds; F2i - Fondo Italiano per le Infrastrutture 29,75%; Altri azionisti privati (n. 523) 0,04%

<sup>8</sup> SEA Group is ISO 14001 certified since 2006.

## Annex K Workshops Netherlands

In the Netherlands several workshops and interviews were held both by ECN and by TNO. Three workshops (w1,2 +3) and three additional interviews (i1,2 +3) were held to create insight in possibilities for improvement when creating smart grids as can be learned from the different cases Couperus, Hoogkerk and EVA-Lanxmeer:

### **i1 – interview to explore experiences in the Couperus-case**

*Technical consultant involved in the lay-out of the smart thermal network interviewed by Mieke Oostra (TNO) on the 25<sup>th</sup> of April 2012.*

The Couperus project in The Hague consists of about 300 dwellings. Heat pumps are used for heating in combination with ground source collectors. The whole complex can be directed in its demand for heating by postponing the demand without the inhabitants noticing. This allows the balance responsible party to steer electricity demand for the heat pumps. They have in fact a virtual power plant. It is possible to deliver heat to the coldest dwellings first. Agreements were made on preconditions and timeframe in which the demand can be altered.

### **i2 – interview to explore experiences in the Hoogkerk-case**

*Consultant involved in the lay-out of the smart grid interviewed by Bronia Jablonska (ECN) on the 16<sup>th</sup> of July 2012.*

The PowerMatching City consist of 25 interconnected household equipped with micro cogeneration units, hybrid heat pumps, solar panels, smart grid appliances and electric vehicles. Additional power is produced by a wind farm and a gas turbine. The aim of this project is to develop a market model for a smart grid under normal operating conditions. The underlying coordination mechanism is based on the PowerMatcher, a software tool used to balance energy demand and use. The aim is to extend this coordination mechanism in such a way that it can support simultaneous optimization of the goals of different stakeholders: in home optimization for the prosumer, reduce network load for the distribution system operator and reduce imbalance for program responsible utilities.

### **i3 – interview to explore experiences in the EVA-Lanxmeer**

*Managing Director involved in the buying and extension of the thermal network of Thermo Bello interviewed by Mieke Oostra (TNO) on the 25<sup>th</sup> of June 2012.*

The residents that initiated the build of the sustainable neighbourhood EVA-Lanxmeer bought the thermal network from their water company. This thermal network provided their houses (170 dwellings) some companies and public organizations (5 additional buildings) with heat. The water company put the thermal network on sale since it did no longer fit in their corporate strategy. The residents were already involved in all kinds of sustainability issues of their neighbourhood and were worried the new owner might increase the rates considerably. Residents are free to financially participate in their new energy company. The network was extended to an additional neighbourhood.

The following workshops were held:

### **w1 Workshop on new scenarios for smart electricity grids– from the supply-side (28-2-2012)**

*This workshop session was organized by TNO with representatives from energy companies (production & supply), energy service providers, a TSO company and DSO companies on the possible scenarios for the network enabling bottom-up DE initiatives.*

The point of departure for this workshop was to think of a new set-up for the electricity system in the Netherlands in order to facilitate DE initiatives. Do we change our standards? Do we alter incentives? Goal of the setting was to explore the possibilities for steering when facilitating the developments of regional and local networks while realizing the societal benefits of smart grids. The basic assumptions were that on a regional level people should be free to make their own choices and that economic principles can be used to steer people to preferable outcomes. Goals to meet

when improving the performance of the electricity system:

- to reduce the amount of energy needed
- to reduce energy transport
- to change towards renewables
- to improve efficiency when producing and converting energy

- to benefit from economies of scale

**w2 Workshop the demand-side (19-2-2012)**

*Together TNO and ECN organized a workshop session with people from different perspectives on the demand side. The participants represented housing associations, local energy companies, initiatives of citizens, lawyers, residents, research institutes and universities.*

After an introduction to E-HUB the workshop started with two presentations on the experiences of local energy initiatives in Hoonhorst and Texel. Texel Energy is involved in solar power, wind turbines, manure fermentation, district heating on prunings and a smart grid pilot. Hoonhorst has initiated 17 projects which include solar power, district heating, fiberglass to facilitate e.g. care-to-the-home, biofuels, biogas from manure, reduction & harvesting of waste, grey water system, village garden etc. Two parallel brainstorm sessions were held; one with people from the perspective of people in local initiatives and one session from the perspective of parties supporting or facilitating local initiatives. Goals were to explore desirable scenarios and wishes, opportunities and possibilities for products and services in the future intelligent energy system.

**w3 Workshop with a municipality (18-6-2012)**

*The workshop was organized by TNO with representatives from different departments in a local municipality (climate policy, environment, construction & housing, e-mobility). This municipality has formulated ambitious environmental goals for 2025 and is looking for ways to realize those.*

Goals were the further clarification of interests, role of the municipality and identification of new opportunities.

**Conclusions from the interviews & workshops**

The conclusions of the workshops and the interviews are clustered under the following headlines: possible scenarios, needs & drivers, roles & responsibilities, barriers & risks, price mechanisms, barriers & risks and opportunities products & services.

**POSSIBLE SCENARIO'S FOR A FUTURE ENERGY SYSTEM**

The ideal energy supply is green, affordable, reliable, varied, efficient and not autarkic. (w1, w2)

Balance between demand and supply is important. (w1, w2)

Local energy supply is important, but we must have a broader look at interaction on various scales, from local to national and even European in order to be able to match demand and supply. Holistic approach (with the ideal of Hoonhorst and Hoogkerk) is important, from a smart city to a smart country and smart Europe. The whole system and all energy forms (gas, electricity, heat, cold and mobility) should be taken into account. (w2)

Three scenarios were considered (w1) in order to facilitate the emergence of regional or local energy networks:

- Business as usual
- Focus on local markets
- Integration of energy carriers

A conclusion drawn (w1) is that there seem to be two options in order to deal with the fluctuation between supply and demand of energy: to invest in smart grids in order to balance the supply and demand or to invest in energy reduction (and buffering) in order to keep the peaks well below the current network capacity.

*Scenario: different regional networks(w1)*

A focus on local market could lead to a different focus per region. In Brabant chicken shit could be chosen as fuel for the generation of heat and electricity, when Rotterdam could chose for rest heat from industry. This will lead to different products and services in the regions. Also standards might vary across the different regions. Some regions might chose for 12 V DC will others will keep their net to 220 V AC. In order to facilitate this, regional networks have to be build and disconnected. The regional networks have to be connected to the national network, preferable with a DC connection. A bit like large industries at the moment.

With the decentralized developments balance should be organized in a different manner. Stochastically this should be manageable and would enable downsizing of regulation. Flexible production facilities are needed to deal with fluctuations. Regional gas facilities of 50 MW seem to be the obvious choice for this purpose. Preferably on green gas.

For the realization of a regional net investments will have to be done. A parallel can be made between the market for mobile phone and energy. A lot of investments were made in parallel networks. Infrastructure and commodity are no longer the problem. In energy we are only at the beginning. This would probably require an increase of 3% on the energy bill. This was considered not to be problematic for most households.

## NEEDS & DRIVERS

Needs and drivers for parties in the supply chain are addressed in the GEN report. These drivers are not repeated here, only those of consumers, bottom-up initiatives, municipalities and housing cooperations.

### Changing consumer needs

There is an emerging tendency among consumers to invest in private energy generation. (i3, w1, w2) During the workshop from the supply-side someone claimed the percentage of people interested lays around 10%. In other markets you see consumers are mainly interested in convenience. (w1)

### Reasons to start local bottom-up initiatives

- concern about energy prices or exploitation costs dwellings in the future (w2)
- to improve the quality of the community (w2)
- to improve social cohesion (especially in areas with declining population) (w2)
- the urge to do something together (is considered great fun!) (i3, w2)
- as a means to jointly save energy (i3)
- control over own energy supply (i3)
- concern about the environment (w2)
- People are not satisfied about how large energy suppliers work. One pointed out that during the liberalization of energy market, a lot went wrong. Companies were not used to clients changing over to other suppliers. (w2) Now these companies have become anonymous entities driven to maximize profit some people feel the need for an alternative which allows for people to be involved themselves (i3).
- A group has more power than an individual and energy supply for a group can be more efficient. (w2)

Formulating mainsprings is important. In the Hoogkerk project (smart grids) the mainspring is "Green". A partner from Germany, MVV Energie, has as a mainspring "Innovative". In Mannheim, the headquarters of the company, people think like this: "MVV is our company", because people have shares in MVV Energie. "Sustainable" could be a mainspring, too. In Hoonhorst, the mainspring could be "Proud of Hoonhorst". (w2)

### Municipalities

Municipality are setting goals to improve sustainability and / or reduce climate effects. It is no longer possible to realize the set of goals on your own as a municipality. While the attention used to lay on actions the municipality could initiate themselves, it now depends on the situation what role is taken. The municipality used to formulate environmental goals as a separate policy line. The experience was that this made it very difficult to involve other departments of the municipality and other stakeholders. Now environmental goals are made integral part of the other policy plans of the municipality. Environmental goals are reframed to sustainable livability, sustainable health and sustainable safety. Support within the municipality has grown considerable as a result. (w3)

Question remains how to mobilize contractors and people to increase sustainability goals in their own organization or household. (w3)

### Housing cooperations

Have the need to distinguish themselves from their competitors and to address the most important driver for renters: to manage their living expenses. In the future energy expenses are expected to rise, therefore solutions are sought to control these. (w2) Another need is to find ways to actively involve renters.

## ROLES & RESPONSIBILITIES

Decentralised energy generation, which is currently rolled out on a large scale, requires much more active roles of different parties who have remained passive up to now. New parties are also joining in. (w1) Each stakeholder should have its own, clearly defined role. (w1)

### New parties

Local initiatives are emerging. With local production the following advantages can be achieved: supporting consumers with energy reduction, decentral balancing, generation at the same location as consumption which reduces transport. (w1) The groups that have set up a successful initiative turned out to be often from close small communities (Hoonhorst, Texel). There are often 1 – 2 enthusiast leaders who can mobilize the community for the realisation of ideas. These close communities stick to their own surroundings and are prepared for more sacrifices for their village, quarter or ward than people who do not have a bond with the locality where they live. This leads to a kind of sentiment to do as much as possible themselves with little external interference. People do not want to be patronized by organisations or the government and be dependent, but they want more and often to decide themselves on their surroundings and ways to take an action. People wish to be involved in the decision process already in the early stages. Furthermore, it is important that the community spirit is stimulated. (w2)

Parties supporting local initiatives will emerge.

Other new players are often small businesses that operate locally (decentralised) and on a small scale. They sell PV for example. These new players often find a position between the end user and the energy supplier/grid operator, and new businesses are created. Texel Energie, for example, has contracted out the grid balancing. (w1) Decentralised generation can lead to congestion on the grid. If this is not solved by the grid operator, the consumer may even end up paying more than before. The grid operator can also contract this out. (w1)

### Existing parties in the supply chain

Current developments lead to changes in roles and responsibilities of existing parties;

Network management and production are divided, this makes optimization difficult. Can we think of providers able to combine both functions? There is infrastructure available, but balancing should be organized. Regional with the responsibility and alignment with the national grid. (w1)

National network should remain the responsibility for TenneT. Regional networks should ideally be under the responsibility of a regional public party. Underneath the regional party several commercial parties can reside. (w1)

Coordinating the capacity of the flexible energy production should be part of the system facilitator or system operator. Program responsibilities and balancing as we know it should be discarded. (w1)

Program responsibility as we know it will disappear. There will be a need for a regional planning function to determine the zoning for generation capacity for a period of 20 years. This can be filled in with concessions. Link the coordinator role with the grid manager. Production can be done by other parties. This could lead to an integral energy company dealing with electricity, warmth & mobility + renewable energy production + related grid management. Not central planning like we used to do in the last century, but facilitating production. (w1) The grid operators need to change the way they are monitoring and react differently to the new developments (such as to the mentioned congestion on the grid which can be solved by placing a battery for storage to set off the congestion). The grid operator needs to identify a business case, but he cannot pass on the risks to the end users. The grid operator is allowed to hire another party to take care of the grid management. For example, another player could start exploiting a small line. This does require different business models. And frictions may also arise in the mutual relationships, because new types of collaboration are involved. (w1)

### Municipalities & housing cooperations

There is a difference between a village with well working social cohesion and a town/city. In a town/city, the local lower authorities or housing cooperations could/should get involved. (w2) The roles they can or should take on are not clear yet. On the lowest administrative level (e.g. city council) support for local initiative could be (other say



should be) organized. The city council could/should create financial space in order to support volunteers and enthusiast people. Furthermore, provincial environment companies could support the initiatives through their web sites. Using the community spirit is also important. (w2)

Possible roles of the municipality:

- When commercial parties take initiative or are prepared to do so to achieve certain goals, the role of the municipality is mainly one of facilitator. (w3)
- The municipality chooses to take on the role of initiator as opportunities are seen to position themselves as interesting community for both citizens and companies. This municipality for example sees opportunities for electric mobility. (w3)
- Creating incentives. To stimulate others to get involved in initiatives the municipality regards as important, financial incentives are created. For existing buildings they facilitate green initiatives and for new buildings they see to it that high standards are met. (w3)
- Setting an example. People dealing with sustainability see intervention in the municipalities' property as a way of setting example for other stakeholders. They would like the municipality take the initiative in converting these buildings. (w3)

Possible roles of housing cooperations:

- Facilitating. To help organize. For example to arrange an excursion to other initiatives in order to promote knowledge exchange (w2)
- To create choice for renters (w2)
- ?? there are still a lot of question marks

## BARRIERS & RISKS

### Risks

The nature of risks involved are related to very different aspects. To give some examples for experiments:

- Insufficient support from residents. In PMC 1, so-called 'technology push' was conducted; within 2-3 days all households were equipped with the technology. The action was prepared through a number of meetings with participants. The technical team responsible for the implementation of PMC would no longer go for the technology push, but instead find out first what the people want, give much attention to social innovation and make clear for oneself what it is they want to the people to learn, taking into account that the simple things are not clear to residents and too complex to grasp. Select a project when the social support is good. Information meetings that offer good explanation are important. You can also start a blog where people can freely exchange experiences and ideas and say whatever they want. It is useful to look into this and to respond if necessary, but people need to feel free to say what is on their mind. (i2) Tip –choose the right approach & focus on people who do not want to participate. At the meetings, people needed to be convinced that they also have influence on the process. You need to let people participate actively in the process. This was also done in the PMC project. (i2)
- The available social infrastructure can collapse. In stage 1, they had no idea as to how people would respond. They first contacted the local authorities to find a suitable location. Hoogkerk was soon identified as a suitable location, because a sustainability committee was already active with various projects in the district. Through the residents' association the idea was brought to the attention; it was an entrance for the residents. Unfortunately, the sustainability committee has been discontinued. (i2) In stage 2, things were done differently. They contacted Groene Power – an SME that sells PV. They already had a lot of contact with people in the area. (i2) Another communication channel in stage 2 was the residents' association. There, they were able to convince people to install PV and to share their energy for which the existing grid is used. (i2)
- An incomplete overview of the situation at the start makes it difficult to indicate progress made in the project. Tip – start with measurements of important parameters at the start. (i2)

- When experimenting with new equipment the question emerges how to deal with the guarantee of appliances, have they been tested? Are they functioning properly? In the PMC project, household appliances worked with the Energy Service Gateway (ESG) system for 'Automatic Meter Reading', i.e. measuring of gas and electricity use. The communication with ESG did not function well because the system is not equipped for this. As a result, people are pulling out. The producer knew that, but nevertheless it is not functioning properly right now; this is a potential risk. (i2) At the time (2009) there were no smart meters that met the requirements of the project. The smart meters were especially developed for the project. (i2) Tip – pay enough attention to ensuring that the technology is functioning well, otherwise people will pull out. (i2)
- Care should be taken that innovative solutions that are tested in practice do not break the law. In some cases it is unclear whether this would be the case. When operating in a way that might break the law, you need to bear the risk and not pass it on to the participants. (i2) Tip from local energy initiatives: if it does not fit in the rules and laws, do it anyway. Make that the existing regulations that hinder the future intelligent energy supply are exposed and criticized. But make sure you keep politicians posted of your actions. (w2)
- One of the tips given was that if you ask the citizens to participate, you should make clear to what extent and on what people can have influence and on what they cannot. If this is not the case, at the end, people are unsatisfied because they have an impression that “nobody listens to them after all.” (w2)

Some examples of risks for local initiatives:

- In local initiatives the competence of people can be a problem; it is difficult to tell your friendly neighbour that he/she is not suitable for a specific task. (w2)
- An important point for some local initiatives is to protect themselves from hostile take-overs. (w2)
- Local initiatives experience that the energy market is very complicated and it is not easy to earn money in this sector. (w2)
- The current system is not tailored for local initiatives. The process needs to be facilitated, people need to be guided, but this cannot be enforced. Developments in PV installations, for example, are progressing so rapidly at the moment that it is difficult to facilitate this from the central system. This requires high flexibility. One example is the smart meters: these are not functioning properly; the preparation takes five years. (i2) At PMC2 there were only few frictions like these. They deliberately opted for focusing on the energy system as it will look like in 2030 and to not be bothered by the potential frictions. (i2)
- The success factor is often, also at the organisations and authorities, the influence of enthusiast individuals. This is immediately a big risk, too, since when this person stops, the continuation of the initiative can be in danger. Sharing responsibilities with more people can lower the risk. (w2)
- Authorities have different interests to look after and have a different pace. A local energy initiative therefore recommends not to involve authorities directly in the initiative. (w2)

#### barriers

There are several reasons why one would like to start an initiative, but there are many barriers. For example legislation and regulations, granting of permits (insufficient knowledge of civil servants/officers), intermediary parties (for example tenants think that the lessors should take the initiative). Another barrier is that often there is a lot of knowledge of procedures or technical issues, but not at the right place and time. (w2)

It is interesting that the housing associations also prefer that citizens come with ideas rather than imposing the ideas top down themselves. Housing associations see the legal requirement of 70% agreement of residents as a big barrier. (w2)

Little research is available in the field of social innovation and there are only few instruments to help you with what you should do and how you should do it. (i2)

During one of the workshops an example was given of a Science Park. Here it was difficult to construct a business case. Earning back the necessary financial investments proved difficult due to split incentives. (w2)

Companies often cannot afford to set up renewable energy projects out of idealistic reasons. There must be a business case and a proper return on investments. A reasonable pay-back scheme of and a suitable business models are important.

The problem is that people often do not understand that due to energy efficiency measures, the rent rises while energy costs diminish. (w2)

A lot of unexpected barriers will rise when starting an energy initiative. A local energy initiative therefore recommends: Just start, do not let them to blow you away! (w2)

#### PRICE MECHANISM & RATES

When implementing smart grids, the users should get the possibility to access the market. Now, the risks (profit and loss) are covered by the energy supplier who, for example, does not pass the price fluctuations on. (w2)

Current pricing mechanism is no longer valid, and should be changed. How the pricing mechanism should look like is not clear yet. At least it should enable people to consume and produce.

Network managers should stimulate buffering. In case energy prices increase dramatically everything will change. Only then options that are now obscure will become interesting, like timing the wash machine with automatic means. Price incentives are too low at the moment. (w1)

Expectations are that at the start cost reduction during the investments in renewables will be key, and not so much price formation and profit maximization. Later on these initial costs will no longer be as important. As soon as wind turbines and solar cells are in place maintenance costs are relatively low. In the workshop someone predicted the fall of energy prices in 2030 due to large investments in renewable energy productions facilities. Energy is almost for free. Transport remains a scarce good. The price-structure for transport has to be remodelled, but how remains unclear. Costs for transport, specially wind parks and larger solar plants, e.g. in the Sahara. (w1)

An important lesson from the times of central energy planning is that the main cause of imbalance in the net is production, not demand. This is probably no different when we change to decentral productions with renewables. (w1)

Integrated production and network on the level of provinces with some overcapacity allows for smoother planning. (w1)

There should be incentives, like in Germany, to use self-produced (solar) energy before it is sent to the grid and to use energy when it is cheap. (w2)

At PMC2, a risk is anticipated with regard to the flexible grid tariffs, for which they want to carry part of the cost themselves. This still needs to be discussed with the Netherlands Office of Energy Regulation. Another risk relates to the energy tax, which should be adjusted according to the used price instead of being a flat rate. (i2)

#### OPPORTUNITIES, PRODUCTS & SERVICES

There should be enough room in the (future) energy market for commercial initiatives between all regulations. What these commercial parties take on and what not is not for the government to decide for. (w1)

#### Products & services to consumer / prosumer

We should not so much look at different types of energy production. An overview is needed where to the end-user requires energy: light, power, heat (high – or low-value), mobility, cooling, and comfort. Also information has value. This leads to new products and services: charge-my-car, ESCO-services etc. (w1)

It could be imaginable that a minimum energy package would be available for everyone with the risk that energy is not available on certain hours. A commercial party could offer you additional energy services against additional fees. Now there is no choice. The commercial party can divide the capacity. (w1)

At the moment you pay a monthly energy bill based on the amount of energy used, why not buy a share in the production? This could lead to a lower energy bill for the investor and would mean a large capital reservoir would become available for investments in renewables. (w1)

#### Other products & services

There was a need for a case manager who would help to get clear how to deal with certain issues. He/she would advise and support the initiative by searching for the right expertise and help with procedures. An independent case manager is to prefer, but someone coming from consultancy does not need to be a problem. (w2)

The TSOs (transmission system operator) like to have small units they can use to balance supply and demand. Especially in certain areas in the Netherlands where the net has more imbalances, like the Westland where greenhouses cause fluctuation in energy demand. This is the reason why there are several projects initiated to displace energy demand. Examples are the Couperus case (see interview) and the project FlexiQuest, which investigates the possibilities to alter energy demand for warehouses and datacentres. (i1, w1)

Furthermore, there is a need for more flexible ways of financing of initiatives. There are many barriers in claiming finance, at banks as well as at the government. Clear financing possibilities would help SMEs to grow faster and citizens to facilitate the initiatives. The financing should not be given too easily; the initiative should not get pampered. Should it be successful, there should be, next to the business case, some combativeness and ability to manage itself. (w2) The desired support is therefore especially consulting and financial support.

Most desired change for this is one in the field of legislative and regulations. One has an impression that the government is more a barrier factor than a facilitating factor. There is a little overview of possibilities (“I can give nowhere questions” and “everybody says something else”). There is a wish that the policy goes through a longer period than one cabinet period. Due to circumstances and (subsidy) regulations changing all the time, many things are unnecessary unclear. (w2)

#### Opportunities to improve preconditions for energy networks (thermal & electricity)

The preconditions can be improved by:

- changing the legal rules. The current rules are not written to realize the current district heating projects. (i1) The same holds true for electricity grids. (w1+3) Today's system is tailored to the large-scale energy market and not to decentralised generation. (i2) The current legislation is tailored to yesterday's situation in which the interests of households and small companies have to be protected against those of large energy companies. (i3) The current system leaves little room for local initiatives from locals to locals (i3, w1, w3). A mayor change can take place when the rules for grid management would be changed. The difference between transport and distribution will disappear. What will be chosen, capacity or congestion? What will be the geographical scope? Rates will change. How will the price for capacity be determined? For commercial parties it will become interesting to anticipate on scarcity. That's very different from now, at least at local level. Transport capacity will become available for everyone. Consumers will not be interested, which means commercial parties will have a role here. This will however lead to sub-optimization. (w1)
- to embed economic principles into the energy system. Incentives to improve the system are lacking since costs are socialized. For thermal grids, as was claimed, the best performing party determines the standard. This sounds as a good thing, but in reality this means parties are taking each other hostage and do not dare to make step change. (i1) Basically the electricity system is a physical and an economical system. First

it was mostly considered as a physical system. There was central planning, which was later discarded. Now the system is also seen as an economic system. Through liberalization the system started to change accordingly. Infrastructure and production were disentangled. It became possible for consumers to choose their own energy provider. Liberalization turns out to be a slow process. At the moment a lot of costs are socialized like: distribution, other network costs, pollution, etc. This means incentives are crooked. When looked at from an economic perspective, you want people to pay for the costs they inflict in the system. This would lead automatically to the best thinkable system. (w1)

- changing the current obligation to connect everyone to the main grid. With the new local energy initiatives the question is emerging whether or not a gas and electricity connection should remain an obligation. The costs to connect everyone to the system are socialized while these people will not use it. This is also an obligation for companies. For example a greenhouse from a grower with his own generation plant will nevertheless be connected to the gas network. In the past 20% of the costs had to be paid by the entrepreneur, now all the costs are socialized while it is not sure whether he would use it. There are however some exceptions emerging, for example in the housing project Hoogdalem in Gorichem (100 dwellings). (i1)
- clarification of outcomes for the dwellers. It is not always clear whether or not a chosen technical solution and business model are advantageous for the dwellers. For example a project of dwellings with a local district heating system on solar energy. An ESCO company is responsible for production and distribution. The residents have a contract with the ESCO firm. What remains unclear is what happens in case of bankruptcy. Will the residents still be able to heat their houses? The habit to make separate legal entities for every 50 to 100 dwellings is not contributing to a trustworthy image. (i1)
- repairing fragmentation in construction. The current fragmentation hampers innovation. Every next party in the supply chain can question the necessity of an innovative solution chosen in the project. Since innovation can influence the work needed from several parties involved it can be hard or almost impossible to get the required outcomes. In the project mentioned above 4 parties were involved. Every part of work was distributed to separate contractors. Pipes and tubing for example and monitoring and control etc. were divided among four parties in total. Every contractor was only responsible & liable for their own task. This made it very difficult to implement the innovations required. (i1)
- knowledge distribution. There is a lot of knowledge scattered among different parties and initiatives that would allow others not to reinvent the wheel. Vehicles for knowledge diffusion are currently lacking. How can we distribute new knowledge as soon as possible? (w2, i3)
- access to finance & information on how to apply for finance. There is a need for new financial constructs. It is very difficult to get banks involved in the finance of local initiatives (i3, w2). These initiatives get more dependent on private equity (i3). The investments necessary are relatively small. This is a problem for most banks. How can we bundle these? (i3) Municipalities and housing cooperations do not have the expertise either (i3, w2).

#### Miscellaneous

A local energy initiative often takes the organization form of a company, but it could instead be an administrative vehicle in which equipment, maintenance and costs & revenue streams are organized (i3)

Knowledge is missing; people do not know what is possible in the energy field. The market is a composition of individuals with low energy knowledge. Explanation and information are very important. It is not possible to react to a question if the question is not formulated yet. (w2) There is a need for a kind of toolbox with processes and solutions as well as best practice cases in order to get questions clearer. (w2)

It is possible to combine company and social goals. One example is the company that runs the ferryboat to Texel. (w2).

In Denmark, people have often shares in an energy company. (w2)